

# futures

MICHIGAN  
AGRICULTURAL  
EXPERIMENT  
STATION

Summer 2004  
Vol. 22 No. 2



RESEARCH  
FOR  
MICHIGAN'S  
HEALTH AND  
WELL-BEING





# Research to Improve Michigan's Health and Well-being

■ *Michigan's children are among the most inactive and sedentary in the nation. There are many other health risks facing children, including poor diets, teenage smoking, unintended pregnancies, infectious diseases and lead poisoning.*

■ *Almost two of every three Michigani-ans are overweight or obese, and the number of Michigan citizens with Type 2 diabetes is rising.*

■ *There are double-digit annual increases in health insurance premiums — with no end in sight. And more than 70 percent of health care costs are directly attributable to chronic disease, much of which could be prevented through lifestyle behavior changes.*

■ *An increasing proportion of the state's general tax revenues must go to pay for Medicaid and other health services in the public sector.*

— Kimberlydawn Wisdom, Michigan surgeon general, in the *Prescription for a Healthier Michigan* report released in May 2004.

## **Nutrition. Immunity. Obesity. Leadership skills for children in foster care.**

These complex issues are extremely important to the health and well-being of Michigan. Because of its name, the Michigan Agricultural Experiment Station (MAES) might not be the first entity you would think of when searching for research on these topics. But the MAES has a keen commitment to strong and healthy families, enhanced rural and urban community development, and profitable Michigan agriculture and natural resource industries. Two of the five MAES target research areas — food and health, and families and community vitality — directly focus on obesity, nutrition and leadership. In this issue of *Futures*, we highlight the work of many of the MAES microbiologists, food scientists, nutritionists, social work researchers and molecular biologists working to tackle these problems from a variety of angles. Studying the issues from all sides will help the MAES provide sound information to policy-makers and Michigan citizens.

To study obesity, the MAES is funding research on the cellular mechanisms our bodies use to regulate fat, how fatty acids regulate gene expression, the relationship between family meals and diet quality, and

Michigani-ans' perceptions of obesity as a personal or public health issue.

Michigan State University is poised to become an international leader in nutritional immunity, and the MAES is funding a variety of projects on food allergies and how our diets affect our bodies' ability to fight off diseases, such as cancer. Other scientists are searching for compounds in foods with medicinal properties (known as functional foods or nutraceuticals) and developing cost-effective processing techniques to bring them to market.

According to statistics from 2001, the last year for which comparative numbers are available from the U.S. Children's Bureau, almost 21,000 children in Michigan were in foster care, making the state seventh in the nation in the number of foster children overall. The MAES is funding research on the factors that affect foster children as they make the transition from the foster care system to independent adult living and how their needs differ from those of children who are not in foster care. Another research area focuses on including child welfare system alumni in leadership and advisory roles within the system. Only six child welfare agencies out of 104 had board members who were child welfare alumni, and no agencies have either a chief executive officer or any executive staff members who are child welfare alumni. Research suggests that those who have actually experienced the system may be able to offer solutions to improve it.

We hope you enjoy this issue of *Futures* and that it helps you understand the breadth of research funded by the MAES. If you have questions or comments, please send correspondence to *Futures* Editor, 109 Agriculture Hall, Michigan State University, East Lansing, MI 48824-1039, or send an e-mail to [depolo@msu.edu](mailto:depolo@msu.edu).

For the most current information about the MAES, I invite you to subscribe to the free MAES e-mail newsletter. Sign up by visiting the MAES Web site at [www.maes.msu.edu/news.htm](http://www.maes.msu.edu/news.htm). Scroll to the bottom of the page and complete the subscription form.

For their generous assistance with the cover photographs, I would like to thank Maren Witzel, Gearl Diggs, Shannon Lake, and Benjamin Forbes and his daddy.

∴ Jamie DePolo

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With one of the most senior researchers in the field and the largest group of scientists in the country, MSU is poised to become an international leader in this growing field.

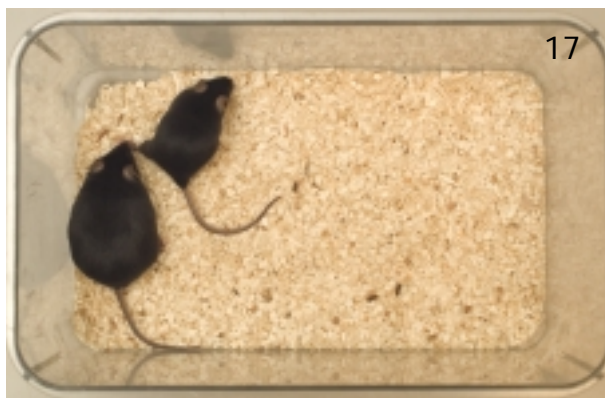
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As a foster child, MAES scientist John Seita experienced the flaws of the system firsthand. As an adult, his research is working to change it and make MSU a national leader in this policy area.

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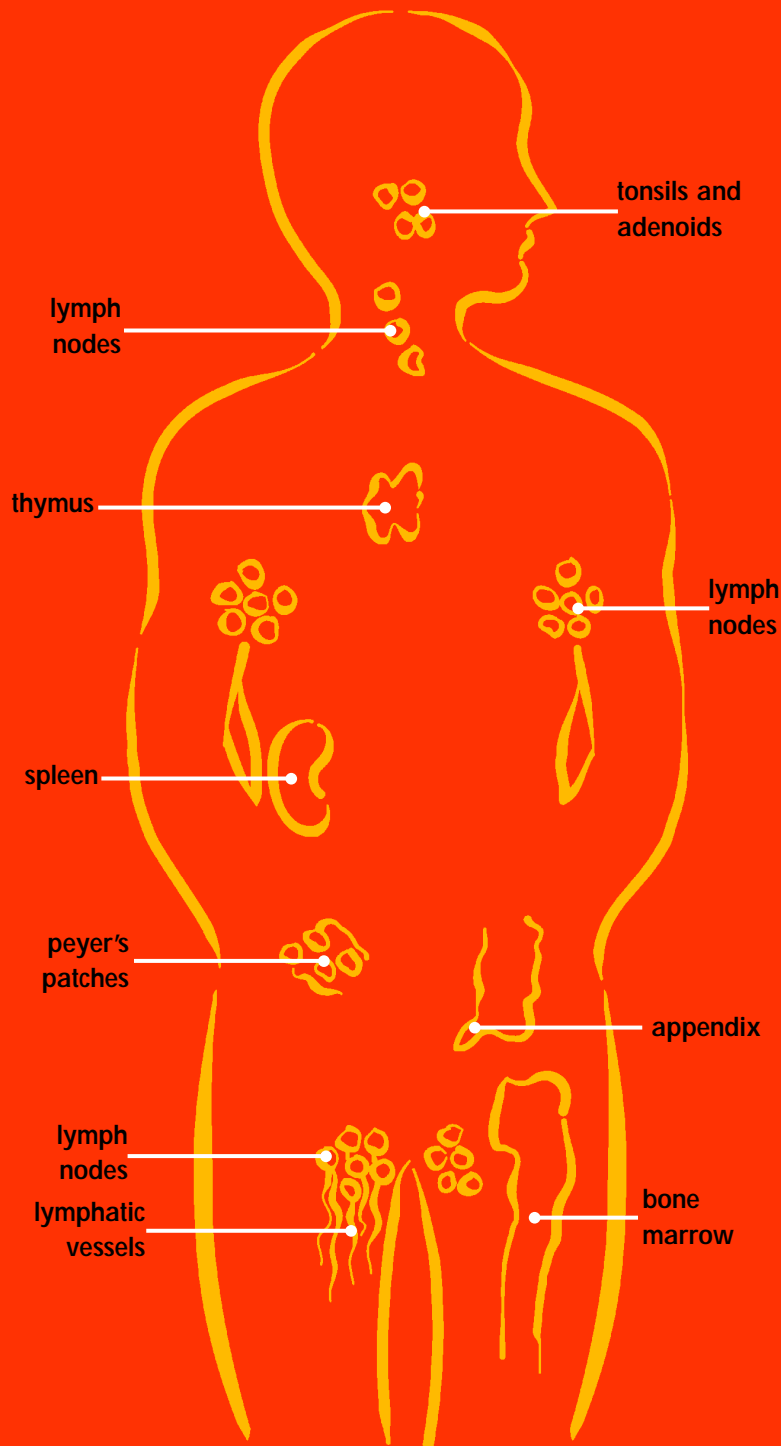
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*Futures* is published quarterly by the Michigan Agricultural Experiment Station. To receive *Futures* free of charge write to *Futures* Editor, 109 Agriculture Hall, MSU, East Lansing, MI 48824, or call (517) 355-0123.

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# Nutritional Immunology



If the immune system were an athlete, it would be Joe Dumars or Steve Yzerman, exerting quiet leadership over the body, stepping up and making big contributions when necessary, but usually letting the brain, stomach and other showboating organs stand in the spotlight and receive all the attention. Most of us don't think about our immune system until we get sick, then we beseech it to work faster, harder, do whatever it takes to get us back on our feet because we can't afford to be sick.

An emerging field of research called nutritional immunology is studying the relationship between the immune system and nutrition and how that close relationship affects the health of people worldwide.

"Poor diets are known to compromise people's defenses against disease, causing increased numbers of infections as well as infections of longer duration," said Pam Fraker, MAES biochemistry, molecular biology, food science and human nutrition researcher. Fraker is one of the foremost scientists in the world in the area of nutritional immunology, and she hopes to make MSU an international leader in the discipline.

"Poor nutrition causes poor wound healing and less than optimal responses to vaccines," she explained. "Many chronic diseases such as AIDS, cancer, gastrointestinal disorders [Crohn's disease, irritable bowel syndrome], renal disease and pancreatitis reduce the body's ability to absorb nutrients and lead to compromised immunity. At the same time, it is now recognized that certain dietary components have the potential to enhance the immune system. Nutritional immunology research wants to document how these components work. We want to put a scientific face on it, rather than relying on anecdotal evidence."

With one of the most senior researchers in this growing field, MSU is poised to become an international leader.

### ■ The Immune System

The immune system is a large complex of organs, highly specialized cells and a specialized circulatory system separate from the blood vessels. All these components work together to clear infection from the body.

The organs of the immune system, positioned throughout the body, are called lymphoid organs. The word “lymph” in Greek means a pure, clear stream — an apt description, considering its appearance and purpose.

Lymphatic vessels and lymph nodes are parts of the special circulatory system that carries lymph, a transparent fluid containing white blood cells.

Lymph bathes the tissues of the body, and the lymphatic vessels collect the lymph and eventually move it back into the blood. Lymph nodes dot the network of lymphatic vessels and provide meeting grounds for immune system cells that defend against invaders. The spleen, at the upper left of the abdomen, is also a staging ground and a place where immune system cells confront foreign microbes.

Pockets of lymphoid tissue are in many other locations throughout the body, including bone marrow and the thymus. Tonsils, adenoids, Peyer’s patches in the intestines and the appendix are also lymphoid tissues.

Both immune cells and foreign molecules enter the lymph nodes via blood vessels or lymphatic vessels. All immune cells exit the lymphatic system and eventually return to the bloodstream. Once in the bloodstream, specialized white blood cells called lymphocytes are transported to tissues throughout the body, where they act as sentries on the lookout for foreign antigens that cause infection. When the

immune system is functioning properly, foreign antigens are detected, marked and destroyed by several types of specialized immune system cells. When the immune system is compromised, it may have difficulty identifying or destroying foreign cells. This may result in illness that may last much longer than it would in someone with a healthy immune system.

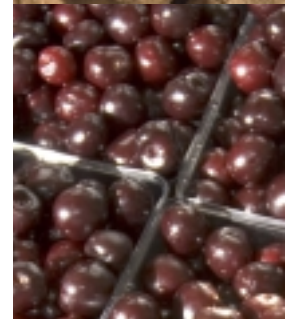
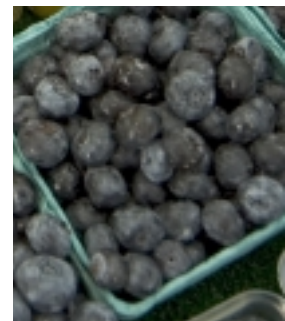
Because the immune system is so large, it undergoes a huge turnover in cells and is one of the major users of nutrients in the body. When people become even slightly malnourished, the immune system is rapidly affected.

### ■ Nutritional Immunology at MSU

Fraker and Jim Pestka, MAES food science, human nutrition, food safety and toxicology researcher, are considered pioneers in the field of nutritional immunology. They and five other scientists form the core of the nutritional immunology program at MSU, making the MSU program the largest in the country. But it is the quality of their work, as well as their numbers, that makes MSU so strong.

“I credit Pam for really coalescing this group,” Pestka said. “She brought us all together.”

“About three or four years ago, I noticed that MSU was hiring three junior scientists — Kate Claycombe, Kathy Hoag and Venu Gangur — who were all working in this area,” Fraker said. Norm Hord, MAES food science and human nutrition researcher, and Walt Esselman, chairperson of the Department of Microbiology, are the other two members of the core nutritional immunology group. “A light bulb just went off over my head, and I explained to everyone what we could do. It is a



## Good food is a way to boost the immune system and get people out of the hospital; good nutrition can facilitate a speedy recovery.

very good group that works well together. We are all committed to interdisciplinary research approaches and have formed new liaisons with physicians in the medical school. We can do good bench science, but we need the health endpoint input as well.”

According to Fraker, incorporating nutritional immunology into health care is the logical next step as the discipline grows.

“It’s ironic that when you’re in the hospital because you have a chronic disease or some sort of trauma or are undergoing surgery, you are given some of the worst food,” she said. “It’s bland and there is a lack of fresh things. Dietitians need to have stronger voices in determining what is fed to patients. Good food is a way to boost the immune system and get people out of the hospital; good nutrition can facilitate a speedy recovery. The hospital is one place that people should have a first-rate diet. Nutritional immunology provides the science to back up these ideas. Homeopaths, dietitians, and organic and natural food providers are all very interested in this work.”

“Diet is underemphasized in medicine,” Pestka added. “Diet is an important component of a healthy life, and dietitians need to play a role in treatment of illness.”

Fraker and Pestka’s theories are attracting national attention. The National Institutes of Health (NIH) helped fund the first national conference in nutritional immunology in July 2003. One of the co-organizers, Fraker was also the keynote speaker at the conference. Fraker and her colleagues are planning a second for 2006.

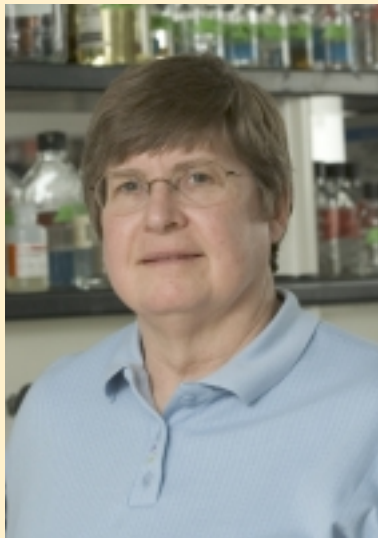
“The NIH is extremely interested in this program,” Fraker said. “They understand that it is small and is going to get much bigger.”

The MSU nutritional immunology scientists specialize in different facets of nutritional immunology, but all are working toward the goal of understanding how diet and nutrition affect the immune system. Some of their specific projects are detailed in the following sections. (Kathy Hoag’s research on vitamin A is on page 12.)

### Zinc and the Immune System

IN HER LAB, FRAKER STUDIES zinc’s effect on the immune system using a zinc-deficient mouse model. Zinc is a micronutrient, an essential mineral found in almost every cell. It is involved in the activity of approximately 100 enzymes and supports a healthy immune system. Zinc is necessary for wound healing, helps maintain the senses of taste and smell, and is needed for DNA synthesis. Zinc also supports normal growth and development during pregnancy, childhood and adolescence.

Little zinc is stored in the body, so people need to consume a daily amount. The mineral is found in a wide variety of foods — oysters contain more zinc per serving than any other food, but red meat and poultry provide the majority of zinc in the American diet. Other foods high in zinc include beans, nuts, certain seafood, whole grains, fortified breakfast cereals and dairy products. Zinc absorption is greater with a diet high in animal protein than a diet



Pam Fraker, MAES biochemistry, molecular biology, food science and human nutrition researcher, is one of the top scientists in the world in nutritional immunology.

high in plant proteins.

“Zinc deficiency accompanies many chronic diseases including AIDS, Crohn’s disease, pancreatitis, renal disease and sickle cell anemia,” Fraker explained. “If you are ill and losing weight, you will be zinc deficient. Zinc deficiency can also be found in children in Mexico, Central America and the Middle East, where diets are low in animal products.”

Fraker’s research has found that zinc deficiency caused the thymus, an immune system organ near the breastbone, to waste away rapidly. It also dramatically reduced the number of lymphocytes in the body. She then determined the cellular mechanisms that caused this to happen and is now examining why lymphocytes that remain in the spleen appear to be more potent.

“It suggests that as the body realizes it is becoming zinc deficient, it may put into place some fail-safe mechanisms to provide some essential immune protection,” Fraker said. “Zinc appears to reprogram the immune system to act differently and express different genes.”

The work has immediate applications. Fraker explained that a researcher in Florida found a subgroup of AIDS patients who were all zinc deficient. They were given zinc supplements and their immune systems were stabilized.

“This was done without drugs, just with zinc,” she said. “That’s the power of nutrition on the immune system. If someone found a drug that reduced AIDS mortality, everyone would have to consider it when treating AIDS patients. I want nutrition to have the same status — it should not be ignored. Anything that can help a patient should be incorporated into the treatment plan.”

## Bacteria and the Immune System

PESTKA BEGAN HIS CAREER STUDYING MOLD TOXINS, WHICH are ever present in the environment, from the food we eat to the air we breathe. To help eliminate these toxins from the food supply, Pestka developed a test kit that uses genetically engineered antibodies to test for mold toxins in grain crops.

Vomitoxin, a member of the trichothecene group, is a toxin produced by mold in corn and other grain crops when they are exposed to excessive moisture. Vomitoxin causes diarrhea in pigs, and other trichothecenes cause illness in humans who eat contaminated wheat or corn.

Heating, cooking and processing have no effect on vomitoxin and other trichothecenes. The only way to deal with these toxins is to remove contaminated materials from the food supply.

Pestka then found that the mold toxins affected animals' immune systems. It was also a good bet that the toxins affected human immune systems.

"People were interested in this, so I expanded my work to how mold toxins affect the human system," he said. "Now I've expanded again, from looking at dietary toxins to studying how probiotics, herbal supplements and lipids affect the immune system."

Beneficial bacteria, such as *Lactobacillus acidophilus* and *Bifidobacterium bifidum*, are called probiotics. Probiotic bacteria favorably alter the intestinal microflora balance, inhibit the growth of harmful bacteria, promote good digestion, boost immune function and increase resistance to infection. A healthy human gastrointestinal (GI) tract contains trillions of bacteria and other microbes. There are several hundred species. People have evolved with these microbes in their GI tracts; they are necessary for healthy digestion and immune function. People with flourishing intestinal colonies of beneficial bacteria are thought to be better equipped to fight the growth of disease-causing bacteria. *Lactobacilli* and *bifidobacteria* maintain a healthy balance of intestinal flora by producing organic compounds — such as lactic acid, hydrogen peroxide and acetic acid — that increase the acidity of the intestine and inhibit the reproduction of many harmful bacteria. Probiotic bacteria also produce substances called bacteriocins, which act as natural antibiotics to kill undesirable microorganisms. Diarrheal diseases that flush the intestinal microorganisms out of the GI tract leave the body vulnerable to infection.

Dozens of supplement products — usually capsules of freeze-dried *Lactobacillus* species, the type of bacteria found in yogurt — are marketed as probiotics.

"But many of these supplements have a number of different organisms added to them," Pestka explained. "Research has shown that some are more beneficial than others. It depends on what type of illness a person has and what the specific bacterium does."

Working with Zeynep Ustunol, MAES food science and human nutrition scientist, Pestka is studying the effect of specific *lactobacilli* on the immune system's ability to respond to infection. They are testing the effect of various *lactobacilli* strains on the expression of cytokines, messenger proteins that help immune



MAES food science and toxicology researcher Jim Pestka is studying how beneficial bacteria, herbal supplements and lipids affect the immune system.

system cells communicate with one another and the rest of the body. Each cytokine causes a different immune response, so if the scientists can determine the response stimulated by a specific strain of bacteria, it would allow probiotics to be targeted much more efficiently.

"Understanding the mechanism of how probiotics affect the immune system will allow manufacturers to create supplements or shakes specifically for people with inflammatory bowel disease, or Crohn's disease," Pestka said. "We will be able to be much more precise."

Pestka is also studying the effect of omega-3 fatty acids on the immune system. A polyunsaturated fat, omega-3s are found primarily in cold-water fish such as tuna, salmon and mackerel, as well as in fresh seaweed and fish oil supplements.

Omega-3s modulate immune system response by reducing inflammation. In many autoimmune diseases, when the body is attacking itself for unknown reasons, inflammation can cause kidney failure and other life-threatening problems. Inflammation is also largely responsible for the pain and suffering of arthritis and colitis. Immunoglobulin A nephropathy (IgAN), an autoimmune disease also known as Berger's disease, causes immunoglobulin A immune complexes to be deposited in the glomeruli (the filters in the kidneys), where they cause inflammation, called glomerulonephritis, and eventual scarring of the glomeruli (called glomerulosclerosis). IgAN is the most common type of glomerulonephritis in the world. Approximately 150,000 people in the United States have been diagnosed with IgAN, and about 4,000 new cases are diagnosed each year. There is no consensus on how best to treat IgAN because current treatments are not very helpful or have undesirable side effects.

Some research studies have shown that omega-3s help IgAN sufferers, while other research has shown no benefits.

In his lab, Pestka found that mice that had eaten grain infected with vomitoxin developed the early symptoms of IgAN. So he substituted fish oil for corn oil in the diets of the mice to study the effect of the omega-3s on IgAN.

“The omega-3s were quite effective in reducing the inflammation,” Pestka said. “They reduced the amount of immunoglobulin A immune complexes produced by the body, which means that

fewer of them will be deposited in the kidneys. By starting to understand how the fish oil works, we can develop better, more precise treatments for these types of diseases.”

### ■ CC-Reactive Protein, Obesity and the Immune System

MAES FOOD SCIENCE AND HUMAN NUTRITION RESEARCHER KATE Claycombe believes that nutrition is preventive medicine.

“I was attending a grand round. [In medicine, case histories are used to illustrate the clinical presentation of diseases, to provide a context in which participants can review basic information, and to focus discussion on several possible ways to frame and address the problem. Various medical specialists present their perspectives on the etiology, diagnosis, prognosis and treatment plan for a patient’s presenting problem. This is known as grand rounds.] A panel of obesity experts, various diet plan representatives and a cardiac surgeon were speaking to the medical students,” she said. “The surgeon talked about his practice, how it was flourishing because he was doing many cardiac bypass surgeries. But then he paused and told the students how he started seeing the same patients again — people he had already done triple bypasses on were back for more heart surgery. This bothered him. He felt that he was treating the illness, not preventing it. He wanted to know what could be done to stop this cycle.

“The surgeon was realizing that nutrients are preventive medicine and that all medical students would need to pay closer attention to diets and prevention of diseases.”

Like Pestka, Claycombe is also interested in inflammation in the body. Because obesity is one of the key risk factors for development of cardiovascular disease, her research focuses on obesity and cardiovascular disease and obesity-associated inflammation.

“Cardiovascular disease is the No. 1 killer in the United States and in Michigan,” she explained. “Obesity is considered to be a low-grade chronic inflammatory disease, and obesity-induced cardiovascular disease is strongly tied to elevated levels of C-reactive protein [CRP]. Research has shown that obese people have higher levels of CRP.”

CRP is a special type of protein produced by the liver that is present only during episodes of acute inflammation. It is part of the immune system’s defense mechanism.

“Studies have shown that people with elevated levels of CRP have a significantly higher risk of heart disease,” Claycombe explained. “Recent studies have shown that CRP can be a more

sensitive way to predict a person’s risk for cardiovascular disease than measuring only cholesterol levels. We’re missing about one-third of the people who don’t have high cholesterol but are at risk for developing heart disease. These patients have low cholesterol levels and yet have elevated CRP levels. As a result, some physicians are starting to order CRP screenings.”

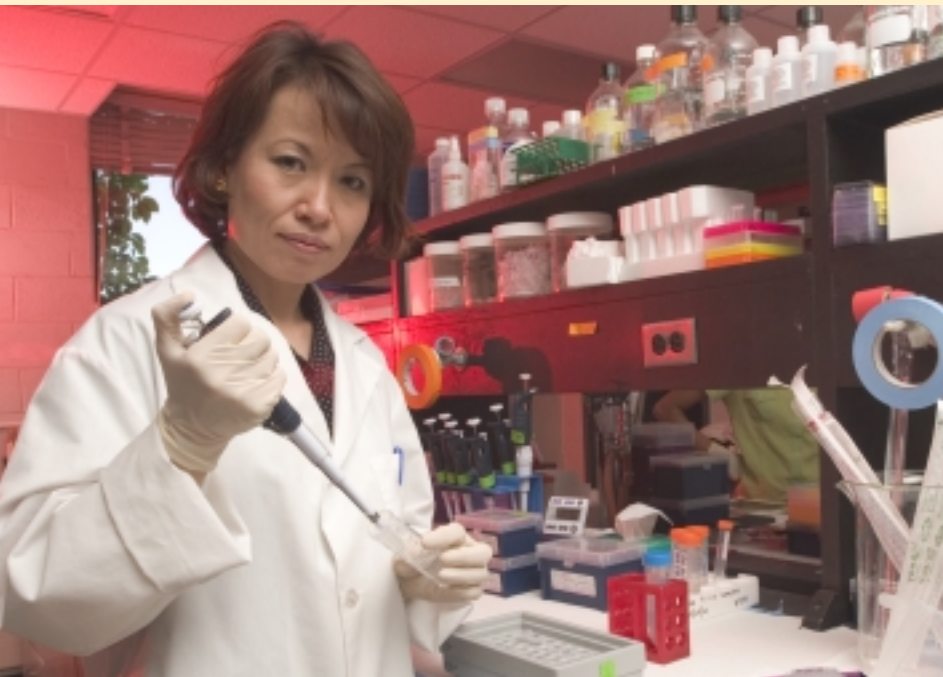
Claycombe is studying the circumstances that cause CRP to be released in hopes of finding a way to lower elevated levels, such as statins lower cholesterol.

“We’re looking for nutrients that can reduce CRP levels,” Claycombe said. “We’re testing the flavonoids of Michigan tart cherries.”

Flavonoids are plant pigments, the substances responsible for producing the bright colors of fruits and vegetables. Many of them are also antioxidants and help lower cholesterol levels.

Like Pestka, Claycombe is also studying omega-3 fatty acids and their ability to reduce inflammation and, consequently, CRP.

“We’ve tested several, and so far fish oil works better than antioxidant vitamins,” Claycombe said.



Kate Claycombe, MAES food science and human nutrition scientist, focuses her research on cardiovascular disease and obesity-associated inflammation.

“We want to understand why some foods trigger allergies,” he said. “What is the mechanism that makes one person allergic to a food, which, in the case of nuts, is a beneficial food? Tree nuts and peanuts are the leading cause of food-induced anaphylaxis, which is potentially fatal. They cause about 30,000 serious, life-threatening reactions a year.”

Systemic anaphylaxis, also known as anaphylactic shock, is a sudden, severe allergic reaction to a substance. Symptoms can

### ■ Food Allergies and the Immune System

ALLERGIC REACTIONS OCCUR WHEN THE IMMUNE SYSTEM OVERREACTS to a seemingly harmless substance. Food allergies afflict millions of people of all ages in this country and around the world. MAES food science and human nutrition researcher Venugopal Gangur is using nut allergies as one model for his studies on food allergies.



include wheezing, hives, itching, swelling of the face and lips, difficulty breathing, vomiting, a severe drop in blood pressure, loss of consciousness and cardiac arrest. The symptoms often happen within seconds and are considered a medical emergency. Most fatalities occur within three hours of food exposure.

“Most allergen research has been on airway allergies,” Gangur explained. “On pollen and asthma, things like that. Food allergies were not studied scientifically for a long time because many researchers didn’t believe that they actually existed. They thought people were just intolerant of certain foods, not actually producing an immune system response to them.”

Gangur, who has been studying allergies for 12 years, is looking at how the immune system makes its decision to react as it does to a non-toxic substance in food and why this happens only in certain people. In his previous work studying airway allergies, he found that the immune system behaves differently in people with allergies.

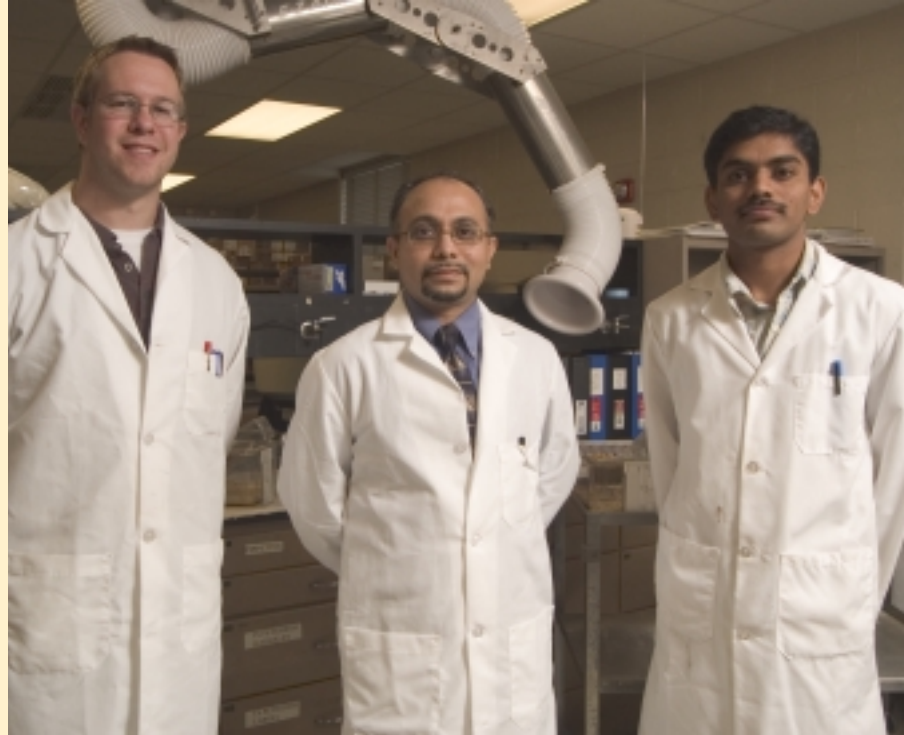
“There is a protein, IP-10, that binds to a specific receptor on immune cells. Everyone makes this protein,” he explained. “But in people with allergies, the cells can’t see it and don’t use it, even though it’s there. In people without allergies, the cells see and use this protein.”

“We are theorizing that the immune system begins to make these types of decisions at the infant level, and that they may begin as the immune system is developing in the fetus,” he continued. “One theory maintains that exposure is critical. We think that if a person is exposed to foods as an infant, then he or she is more likely to have allergies to the food. So if a mother eats peanuts, the proteins from the peanuts are in her breast milk and the infant is exposed to peanuts that way. We don’t know if antibodies alone cause allergies — we want to understand the cellular mechanisms of the response.”

To study the idea that allergies are programmed during fetal development and are the result of exposure to toxic substances, Gangur is working with Wilfried Karmaus, associate professor of epidemiology at MSU, and the Michigan Department of Community Health on a project funded by the Environmental

Protection Agency (EPA). The researchers are studying immune systems in babies, pregnant women and women who have just given birth in Benton Harbor.

“We’ve just started this project,” Gangur said. “The research assistants in my lab are beginning to screen the sample population. We hope to find biomarkers that can help us predict who will have allergies of any type. Then we could identify people at high



MAES food scientist Venugopal Gangur (center) is examining why some foods trigger allergies in certain people. Neil Birmingham (left) and Sridhar Samineni (right) work with him in his lab.



Gangur uses nut allergies as a model for his work. Tree nuts and peanuts cause about 30,000 life-threatening reactions per year.

risk so they could undergo controlled testing and avoid a life-threatening situation.”

Another of Gangur’s projects is addressing the same issue from a different perspective.

“Some studies have shown that if a mother breast-feeds her baby, it may offer allergy protection,” he said. “Other studies have indicated that breast-feeding has no effect on allergies, and other studies indicate that breast-feeding promotes allergies. It’s very confusing for both scientists and new mothers.”

Gangur’s hypothesis is that not all breast milk is equal. If a mother has allergies, then it is likely that her breast milk will promote allergies in her child. If a mother does not have allergies, then her breast milk will not promote allergies and may actually offer some protection to the infant. He and his colleagues are testing the hypothesis.

“We’ve just started this project as well,” Gangur said. “We hope to be able to provide better information to pregnant women and new mothers who are making decisions about how to feed their children. We want to identify the factors in breast milk that promote allergies as well as those that offer protection from allergies. From there, we will be able to offer a screening process to new mothers so they can have the best information available when deciding whether to breast-feed or not.”

## Colon Cancer and the Immune System

COLON CANCER AND OTHER INFLAMMATORY BOWEL DISEASES ARE caused by chronic inflammation resulting from the complex but not well understood interactions between bacteria in the colon, colon epithelial cells (cells that line the colon) and the immune cells in the colon. Eating a diet high in saturated fat, charbroiled meat and alcohol is linked to a higher risk of colon cancer. In the United States, colon cancer is the fourth most common cancer in both men and women and the second leading cause of death among cancers, trailing only lung cancer. The American Cancer Society estimates that 146,940 cases of colon cancer will be diagnosed in the United States in 2004 and 56,730 deaths will occur.

“Colon epithelial cells are supposed to live only two to five days, but those that become cancerous live longer than they are supposed to,” said Norm Hord, MAES food science and human nutrition researcher. His research focuses on dietary compounds that may intervene and prevent colon cancer. “A normal epithelial cell is created, migrates up to the top of the epithelium and then differentiates [becomes committed to the job it is going to do, such as secreting water]. Then it undergoes a normal cell death.”

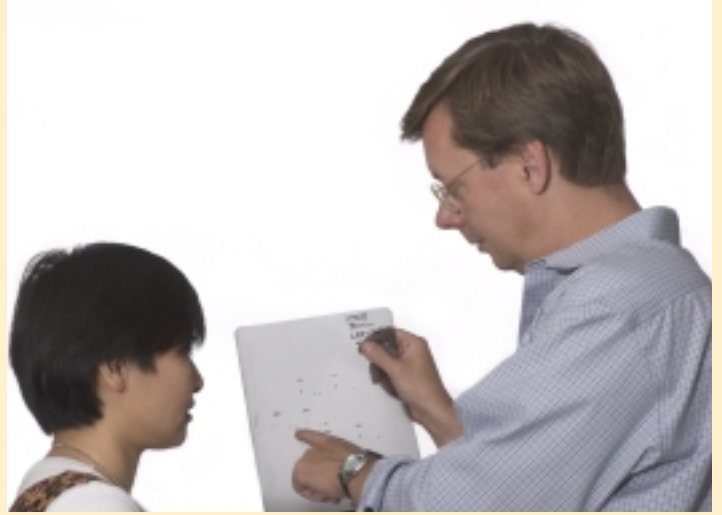
In this manner, the colon keeps a balance in the number of cells and everything works properly. But if a cell does not migrate and differentiate, it mutates and does not die, causing an imbalance in the number of cells in the colon. These mutated cells survive, divide and may eventually become precancerous lesions called polyps. Though less than 1 percent of polyps turn into tumors, removing polyps greatly reduces the risk of colon cancer, which is why so many people have this type of surgery.

“When polyps form, we know that it is due to a defect in a gene called APC [adenomatous polyposis coli],” Hord explained. “APC plays a large role in colon cancer and may also be linked to breast and pancreatic cancer.”

Hord described APC as a “gatekeeper” gene because it influences the rate at which other important growth control genes, known as “caretaker” genes, mutate and promote cancerous growth. One of APC’s roles may involve cell death.

“When the APC gene is normal, cells migrate and die [by a process called apoptosis] the way they should,” Hord said. “If APC is mutated, other important genes also mutate, and cells fail to migrate and proliferate.”

The relationship with the immune system cells in the colon becomes important at this point. Colon cancer risk is known to be higher in people with inflammatory bowel diseases such as ulcerative colitis. This may be because normal epithelial cells make a large number of proteins, called chemokines, that send signals to the immune cells that patrol the colon. The immune cells normally recognize and kill cells that have become cancerous. However, preliminary research data from Hord’s lab indicate that precancerous epithelial cells may evade detection by immune cells because they make fewer of these proteins and smaller



Norm Hord, MAES food science and human nutrition researcher, reviews data with Yanfen Zhai. Hord’s research focuses on dietary compounds that may prevent colon cancer.

amounts of them. This could allow the precancerous cells to survive to form a polyp or tumor.

Research has shown that if the epithelial cells migrate, they will differentiate and then die as they are supposed to, even if they are mutated — the cells’ failure to migrate is what causes colon cancer. So like Kate Claycombe, Hord is studying flavonoids to see if they can cause the cells to migrate even if the APC gene is mutated and the cells are abnormal. He uses mouse cells in his lab.

“We’ve looked at curcumin, a compound found in the curry spice turmeric, to see if it causes the cells to migrate,” Hord said. “Curcumin is just amazing — it prevents cancer in every stage. In India, where curry dishes are very common, the prevalence of colon cancer is far lower than in the United States. We have shown that curcumin stimulates cell migration in cells that express mutated APC by stimulating enzymes called matrix metalloproteinases [MMP]. These enzymes essentially clear the way for migrating cells to move up so they differentiate and die as they should.”

Certain flavonoids in apples, onions and tea appear to have the same effect as curcumin on cell migration, and Hord is studying them to determine which are effective in inducing migration in precancerous cells.

“The native compounds from the plant appear to have a better effect than the pure flavonoid,” Hord said. “So people may be better off eating an apple than taking a supplement in pill form.”

While Hord’s preliminary results show that the flavonoids are effective, he said it may take time for these results to translate into dietary recommendations and treatment plans.

“You need many types of evidence to prove the effectiveness of dietary factors to prevent specific cancers,” he said. “You need human studies to document the effective dose and any negative side effects. Basic scientists like me are just the first step in a long process to justify specific dietary recommendations to prevent cancer.”

## Functional Foods, Health and the Immune System

FUNCTIONAL FOODS, NUTRACEUTICALS, HEALTHY FOODS AND WELLNESS foods — they are all names for the same thing: a food or food ingredient that provides a health benefit beyond basic nutrition; in other words, a food that has medicinal effects. While popular

lore has long touted the healthy effects of certain herbs, fruits and vegetables, it wasn’t until 1997 that the U.S. Food and Drug Administration (FDA) awarded the first food-specific health claim. It was to the Quaker Oats Company for a claim relating consumption of oat bran to reduced risk of coronary heart disease.

Functional food research is one facet of the nutritional

immunology program at MSU. Norm Hord and Kate Claycombe's work with flavonoids is functional food research, as is Jim Pestka's work with fish oil. As the food and human nutrition scientists use microbiology to understand and map out the way the compounds interact with the body, biosystems and agricultural engineering scientists help optimize the processing of the compounds for production. This is where Kirk Dolan comes in. Though not a member of the nutritional immunology group, Dolan studies ways to transfer the information the nutritional immunology scientists discover into products that can be sold commercially.

An MAES food engineering researcher, Dolan is working with Maurice Bennink, MAES nutrition researcher, to develop a processing method for the commercialization of functional food components once they have been identified.

"The U.S. market for functional foods was \$19.6 billion in 1999 and is expected to triple by 2010," Dolan said. "Functional foods make up about 10 percent of the total food market. Nearly two-thirds of grocery shoppers report that their purchase decisions are driven by their desire to either reduce risk for or manage a specific health condition. Many of the larger food companies have established functional food divisions."

Dolan said Michigan is in a unique strategic position to benefit from this growing market. The state is second only to California



Dolan uses seconds, culled and inedible material to study processing techniques. Functional foods may provide Michigan growers with a market for material they are now disposing of as waste.

in the diversity of agricultural crops grown, and about half the population of the United States and Canada is within 500 miles of the state. This provides convenient access to markets.

"We want to identify the health-promoting compounds in Michigan crops," Dolan said. "Since Michigan grows so many fruits and vegetables, we had a number of crops to choose from."

Though blueberries, grapes, cucumbers, green peppers, radishes, turnips, carrots, apples, onions and mint are all crops with potential health benefits, the scientists are initially focusing on grapes, blueberries and onions. Michigan ranks in the nation's top 10 for production of these three crops. What they have in common is the highest levels of phenolic compounds, a type of flavonoid. During processing of these crops, large quantities of



MAES food engineering scientist Kirk Dolan is working to develop processing methods for functional food compounds. Shown here are two samples of blueberry powder.

seconds and culled and inedible material, such as grape skins, are thrown away as waste. This provides Dolan with a large supply of free raw material.

"These foods have been shown to have beneficial effects, so we're trying to develop and optimize processes to produce commercial products, whether they are liquids or powders," Dolan said. "For example, we're extracting, filtering and evaporating blueberries and grapes to get a liquid concentrate. From there, the concentrate can be sold as-is as a base or ingredient for blueberry syrup, blueberry or grape toppings, or fruit fillings.

Because all the raw materials for the products are waste, the only costs involved are processing costs. As an engineer, Dolan sees himself at the end of the functional food production process, figuring out how to make the product in large volume in a cost-effective way.

"It's to everyone's benefit to spend the money now, before large-scale production is launched, to determine the best and most efficient production techniques, rather than trying to fix a problem at the plant level," he said. "My job is to transfer the information so it's equipment independent. I want to boil it all down and give someone a cost in dollars per milligram of beneficial compound. The industry is very excited about this. It's a way to add value to Michigan crops and take advantage of existing processing techniques."

::: Jamie DePolo

How Does It Work?

How Can More People Get Enough of It and Other Micronutrients?

# Vitamin

# A

**V**itamin A belongs to a group of nutrients known as micronutrients, compounds present in small amounts in the body that are not used for energy but are still necessary for good health. Vitamin A plays an important role in vision, bone growth, reproduction, embryonic development, cell division and cell differentiation, the process by which a cell decides what it is going to become. It helps maintain the integrity of the skin and surface linings of the eyes, as well as the mucus membranes of the respiratory, urinary and intestinal tracts. When those linings break down, bacteria can enter the body and cause infection. Vitamin A also helps regulate the immune system.

Vitamin A deficiency causes night blindness and ultimately blindness, growth retardation, damage of mucous membrane tracts and reproductive disorders. Children with vitamin A deficiency are often deficient in multiple micronutrients and are likely to be anemic, have impaired growth, and be at increased risk of dying from common childhood infections such as diarrheal diseases and measles.

In the United States, vitamin A deficiency is rare.

Vitamin A is found in whole milk, liver, whole eggs and a variety of dark-colored fruits and vegetables such as broccoli and carrots, usually in the form of provitamin A or beta carotene. Breakfast cereals and milk are fortified with vitamin A to ensure that people consume the necessary amount. But in developing countries, vitamin A deficiency is the norm, not the exception. Approximately 250 million children are at risk for vitamin A deficiency world-

wide, and about 4.4 million preschool-age children have visible eye damage due to this deficiency. Annually, between 250,000 and 500,000 preschool children go blind from a lack of vitamin A, and about two-thirds die within months of losing their sight.

“What happens is that kids die from diseases that are easily controlled by vaccination programs in the United States,” explained Kathleen Hoag, assistant professor in the Medical Technology Program and the Department of Food Science and Human Nutrition, who is also a member of the Nutritional Immunology Program. “If the kids are vitamin A deficient, they don’t respond to the vaccine and end up dying from diseases that are preventable. It’s tragic.”

“Large numbers of people in developing countries exist on simple diets composed primarily of a few staple foods — cassava, wheat, rice and corn — that are poor sources of micronutrients,” said Dean DellaPenna, MAES biochemistry and molecular biology scientist. “Micronutrient malnutrition affects more than half of the world’s population, especially women and children. The costs of these deficiencies in lives lost, forgone economic growth and poor quality of life are staggering.”

“We’ve known since the 1930s that an insufficient amount of vitamin A in the mother during pregnancy results in fetal death or abnormalities in the offspring, including heart and central nervous system abnormalities,” said Maija Zile, MAES nutritional sciences researcher. “Without vitamin A, there won’t be any embryonic development.”

Hoag, Zile and DellaPenna are each examining a different facet of vitamin A with the goal of benefiting those who are vitamin A deficient. Hoag is studying the mechanisms that vitamin A uses to improve the response of the body’s immune system to infections. Zile is working to determine which events in embryonic development are controlled by vitamin A. DellaPenna, as part of an international nutritional genomics team, is working to breed and engineer staple crops with higher levels of beta carotene and other micronutrients.

#### HOW DOES VITAMIN A HELP THE IMMUNE SYSTEM?

Hoag is studying vitamin A’s effect on the immune system at the cellular level to determine exactly how the micronutrient affects immune function. Research has shown that vitamin A-deficient humans and animals do not produce enough antibodies to fight an infection. B lymphocytes,



Kathy Hoag, a food science and medical technology researcher and member of the Nutritional Immunology Program, is studying vitamin A’s effect on the immune system at the cellular level.

cells produced in the bone marrow, are responsible for producing all antibodies. But these cells need help to create an optimal response to infection. One type of cell that assists is known as a T helper 2 cell (Th2).

“In earlier work, Dr. Colleen Hayes and her colleagues at the University of Wisconsin-Madison found that vitamin A-deficient mice had a dramatically lower number of Th2 cells,” Hoag explained. “When the researchers gave them vitamin A supplements, the number of Th2 cells increased. So my research moved backwards to find out how a lack of vitamin A reduces the number of Th2 cells.”

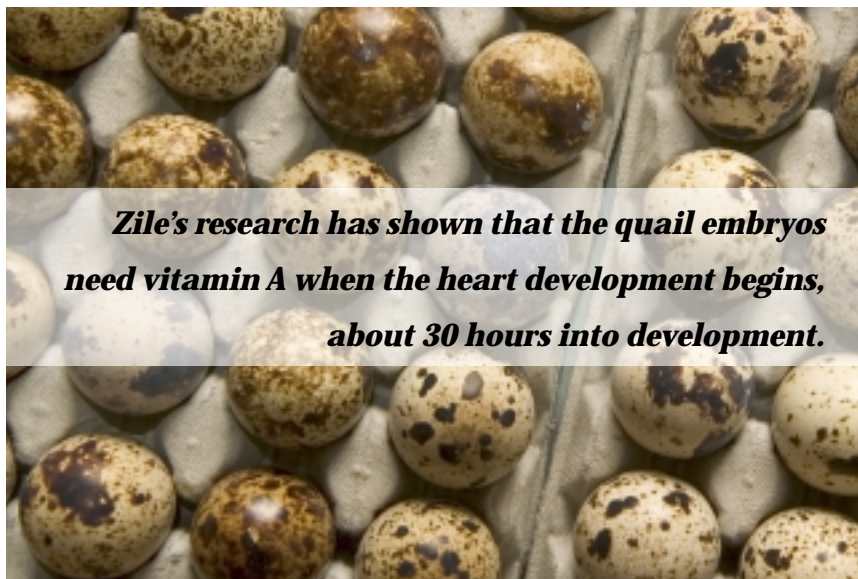
When infection attacks the body, the foreign cells have to be processed before the body can fight off the infection. Protein fragments from this processing are shown to the T cells by the processing cells, which are known as antigen presenting cells. The T cells then go to work and fight the infection. If the foreign cells are not processed and presented by the antigen presenting cells, the T cells cannot recognize and fight the infection. Hoag and her colleagues theorized that a lack of vitamin A might mean that there were fewer antigen presenting cells to serve the T cells. This would result in a lower number of Th2 cells as well as a decreased immune response to an infection.

“So we added vitamin A to both antigen presenting cells and T cells,” Hoag explained, “and we got a good immune response. Then we added vitamin A to T cells only and we didn’t see any improvement in immune response. But when we added vitamin A to antigen presenting cells, bingo, we got a good immune response.”

The scientists now had proof that vitamin A directly affected antigen presenting cells. Again, they looked backward from the antigen presenting cells to determine the mechanism that vitamin A used.

They began with myeloid dendritic cells, a type of antigen presenting cell. These dendritic cells develop from what are called precursor cells in bone marrow.

They took bone marrow precursor cells and added GM-CSF which is a cytokine. Cytokines are messenger proteins that help immune system cells communicate with one another and help the immune system communicate with the rest of the



body. Cytokines can stimulate or inhibit the growth and activity of various immune cells, such as dendritic cells. GM-CSF is a cytokine that directs precursor cells to develop into myeloid dendritic cells.

"We created a model so we could control the amount of vitamin A in the systems," Hoag said. "In those that had vitamin A, 60 to 70 percent of the precursor cells turned into dendritic cells. In those without vitamin A, only 10 percent of the precursor cells turned into dendritic cells.

"Interestingly, there was no decrease in the number of cells produced from the precursor cells without vitamin A," Hoag continued. "They were turning into neutrophils, another immune system cell, but one that has no function in antigen presentation. We were one of the first research teams to demonstrate this in the lab."

Hoag said that scientists had observed that vitamin A-deficient animals had increased levels of

neutrophils in their blood and spleen, but no scientific study was done on this. Neutrophils usually turn over rapidly in the body, living for a short time and then dying. Researchers thought the higher levels of neutrophils in vitamin A-deficient animals meant that the neutrophils were not dying as quickly as they normally did. But Hoag's research demonstrated that the animals were producing more neutrophils because they lacked vitamin A.

Neutrophils recognize patterns in foreign cells but are not antigen specific. So they can lower the level of bacteria or viruses in the body, but they cannot clear the infection completely.

Hoag is now looking backward again, trying to determine the mechanism that causes change in precursor cells.

"We're trying to figure out the molecular signals that cause the precursor cells to change into dendritic cells or neutrophils," Hoag said. "If we understand that, we may be able to get the body to create more dendritic cells, which would boost immune response."

#### VITAMIN A AND EMBRYONIC DEVELOPMENT

Like Hoag, MAES researcher Maija Zile is interested in the cellular mechanisms in the body controlled by vitamin A.

"Mammals need vitamin A to reproduce," Zile explained. "Without it, females won't produce viable eggs and males won't have any sperm. We're trying to pinpoint the events in embryonic development that require vitamin A."

In her research, Zile uses quail embryos as models. Birds can use retinoic acid as a form of vitamin A; however, this form is not passed on to the eggs, so Zile can study embryonic development in eggs with no vitamin A at all.

"With the vitamin A-deficient egg, we can see how far the embryos will develop," Zile said. "The early stages of embryonic development are very similar across species, so this work may be very applicable to humans. We can then add vitamin A at various stages to determine when the quail embryos begin to require vitamin A for continued development. We know that after about three days without any vitamin A the quail embryos will die."

Zile's research has shown that the quail embryos need vitamin A when the heart development begins, about 30 hours into development (this corresponds to about 2 to 3 weeks of human embryonic development). Without vitamin A, the heart fails to develop an inflow track which it needs to join the vascular system. The heart ends up looking like a

big balloon, has no chambers and does not have a link to the blood supply. Zile and her colleagues are studying the genes that control heart development to see which ones are expressed with and without vitamin A.

“Congenital heart defects occur in approximately 12 out of every 1,000 live births,” Zile said. “Pediatric heart defects account for 12 percent of childhood deaths, and 3 percent of all children have major heart malformations at birth. We don’t know the cause of these, and this research may help us understand and eventually offer treatments for heart defects. We do know that in countries without good nutrition, there are more heart defects.

“If we can understand the basic mechanism of how the heart is formed and what the role of vitamin A is, we may be able to help many people,” she continued. “Understanding that vitamin A plays a role so early in embryonic development may change the way nutrition information is given to pregnant women.”

#### ENGINEERING RICE WITH MORE BETA CAROTENE

MAES scientist Dean DellaPenna is attacking vitamin A deficiency from a different angle. An expert in genetics and plant breeding, DellaPenna is experimenting with ways to breed plants with



MAES food science and human nutrition researcher Maija Zile uses quail embryos as models to study how vitamin A affects development of the cardiovascular system.

to use the full potential of agricultural science, genetics, molecular biology and genomics on the persistent problem of micronutrient malnutrition in the developing world.”

There are three ways to fight micronutrient malnutrition: supplementation, fortification and food-based approaches. Currently, most efforts focus on providing vitamin supplements and fortifying food during processing. Unfortunately, in many developing countries, people eat only what they can grow — their consumption of processed foods and supplements is minimal.

MSU, led by DellaPenna, is the coordinating institution of the nutritional genomics team of HarvestPlus, a global research initiative to breed and disseminate nutritionally-enhanced crops. The first crops targeted for development by the HarvestPlus initiative are those most widely consumed in the developing world — rice, wheat, maize, beans, cassava and sweet potato. The structure of HarvestPlus mimics the way science is done in medicine, DellaPenna said. Several disciplines join together to address the problem — from nutritionists working in developing countries to identify specific nutritional needs to experts in genetics, molecular biology and biochemistry to unlock pathways and employ recent breakthroughs in genomics to help plant breeders to develop new crops.

The nutritional genomics team — DellaPenna, Peter Beyer at the University of Freiberg, Germany, and Michael Grusak at the USDA/ARS Children’s

#### Percentage of children under age 5 with vitamin A deficiency by country

<b>Benin</b>	<b>70</b>
<b>Kenya</b>	<b>70</b>
<b>Central African Republic</b>	<b>68</b>
<b>Uganda</b>	<b>66</b>
<b>Zambia</b>	<b>66</b>
<b>Gambia</b>	<b>64</b>
<b>Senegal</b>	<b>61</b>
<b>Ghana</b>	<b>60</b>
<b>Malawi</b>	<b>59</b>
<b>Namibia</b>	<b>59</b>

Sources: Micronutrient Initiative and United Nations Children’s Fund

higher levels of provitamin A and E.

“Modifying the nutritional composition of plant foods is an urgent worldwide health issue because basic nutritional needs for much of the world’s population are still unmet,” DellaPenna said. “We have

Nutrition Research Center in Houston — will focus on the biochemical processes involved in the synthesis of vitamins and accumulation of minerals to determine how to biofortify edible plant parts with new or increased micronutrients.



A vitamin A-deficient quail embryo is on the left and a normal embryo is on the right. Without vitamin A, the heart fails to develop an inflow track, which it needs to join the cardiovascular system. The scientists can restore normal development by adding vitamin A to the embryos.

“You can eat all the rice you want, and you still won’t get your daily requirement of provitamin A — beta carotene — it’s produced in rice leaves but is not accumulated in rice seed,” DellaPenna said. “But one member of our nutritional genomics team, Peter Beyer, already has shown that rice can be engineered to produce provitamin A in seed. Similar approaches using breeding and genetic engineering, when appropriate, can be employed in rice and other crops to positively affect the micronutrient quality of food in the diet of the world’s poor. The impact has the potential to truly change the daily lives of more than half the world’s population.”

By using a model plant that has had its genes sequenced, such as *Arabidopsis*, a small weed in the mustard family, DellaPenna works to enhance micronutrient levels there and then transfers that work to crops.

“It’s like having an encyclopedia, but all the pages are out of order,” DellaPenna explained. “Most plants have the same genes, the same pages — we just need to put them in the right order.”

“Over the years, breeding has increased yield and resistance to pathogens,” DellaPenna continued. “Now we’re looking at increasing the quality of the food, as well as the quantity.”

Rice, which has no carotenoids (provitamin A

compounds), offers the scientists nothing to breed with to increase the levels of provitamin A. So the researchers have to import carotenoid-producing genes from another plant.

“We have to use genetic manipulation to get provitamin A into rice,” DellaPenna said. “For other crops, such as corn, which is yellow and already has some carotenoids in it, we can select for varieties that have higher levels of carotenoids. These conventional breeding techniques may work faster. We want to use all the tools available to us to combat malnutrition.”

Each crop selected by the HarvestPlus initiative has advantages and disadvantages for the researchers. Rice has a simpler genome than wheat, and its genome has been sequenced. The genome is the unique genetic code or hereditary material of an organism, carried by a set of chromosomes in the nucleus of each cell. The human genome contains an estimated 50,000 to 100,000 genes. The wheat genome is five times the size of the human genome and 35 times larger than the rice genome.

“The first tier of crops was selected because of the infrastructure and coverage on the planet,” DellaPenna explained. “We’re starting with six and then will move on to the other 36.”

But DellaPenna is quick to point out that his work is not a magical cure and is not something that will continue indefinitely.

“The application to the real world is very simple, and it’s not something that will continue forever,” DellaPenna said. “I hope to put myself out of a job. This research is the right thing to do. People are dying from malnutrition, and this can help them. I’m working to help the next three to five generations. By then, I think many of the developing countries will have the infrastructure in place to solve micronutrient malnutrition with fortification. But right now, we can’t fix the problem with fortification. This work will make a larger percentage of the world’s population nutritionally sufficient. There are always going to be people that need air drops of food because of typhoons or floods or other disasters. But if we can make the level of sufficiency encompass a larger group of people, we’ll have been successful.”

“There are social, economic and political issues that surround this work,” he concluded. “Even if we have the crops, other things have to happen. It’s not a silver bullet. But I want the crops to be there to be used when the time comes.”

∴ Jamie DePolo



Michigan residents top the  
swelling ranks of super-sized Americans

MAES researchers are attacking the problem from all sides

# The ~~Fattest~~ of the Land

It's official: according to data released by the Centers for Disease Control and Prevention (CDC), Michigan is one of the fattest states in the country, and Detroit is the fattest city. More than 25 percent of Michigan residents are obese, placing the state second in the nation. Mississippi is first with 27 percent obese residents.

Obesity costs the state an estimated \$3 billion a year. Seven percent of all medical expenses in the state are related to obesity, and half of that is paid for by taxpayers through Medicaid and Medicare. Obesity is Michigan's most expensive preventable public health killer and is on track to overtake smoking as the deadliest, according to research by RTI International and the CDC. Both obesity and smoking kill about 400,000 people per year. Health problems linked to obesity — heart disease, diabetes, stroke, arthritis, gout, high blood pressure, certain cancers and depression — cost about \$300 for every man, woman and child in the state. This drags down the state's already lackluster economy. Michigan is a less attractive place to do business because of higher health insurance costs, absenteeism at work and lower productivity.

"The data are so staggering that they're becoming impossible to ignore," said Ronald Davis, director of the Center for Health Promotion and Disease Prevention at Henry Ford Health System in an article in *The Detroit News*.

Despite flurries of ads hawking "miracle fat melter" pills, powders and drinks in every available media outlet, there is no simple cure for obesity. Experts agree that Michigan's collective girth is due to a number of complex, interrelated factors:

- ✓ Unhealthy food choices. Nearly three-quarters of Michigan residents do not eat the recommended number of servings of fruits and vegetables per day.
- ✓ Long winters, unsafe neighborhoods, a lack of sidewalks or bike lanes for those who do want to use something other than a car to move around, and lack of access to health clubs. A quarter of residents get no regular exercise.
- ✓ As schools put more resources into raising test scores, physical education classes have been cut or drastically reduced. Children grow up with no history of exercise or other physical activity.
- ✓ An increase in poverty in the state means more families are eating cheaper, starchier, fatter and more sugary foods.

The obesity epidemic is clearly more than just a matter of how much we eat.

“Obesity is complex,” said Sharon Hoerr, MAES food science and human nutrition scientist and member of the MSU Community Nutrition Program. “Biology and genetics interact with environmental factors and psychosocial development. We need research on behavior, sociology, the human environment, biology and policy to solve this problem. Nutrition information alone won’t do it.”

“It has to happen at the grass-roots level,” added Beth Olson, MAES nutrition researcher. “The government alone won’t be able to fix this. It has to be a resource for information and promote groups’ coming together.”

Food and health is one of five target areas driving the MAES research agenda over the next decade, and the MAES has a number of scientists studying obesity from all sides.



*Health problems linked to obesity cost about \$300 for every man, woman and child in Michigan.*

Is Our Culture Making Us Fat?

“What happens to the rates of obesity when a country restricts access to butter, eggs, sugar, meat, gas and rubber?” Hoerr asked philosophically. “The answer is that obesity levels go way down. This is what happened during World War II, when so many items were rationed. We were much healthier. Everyone had their victory gardens and ate lots of fruits and vegetables.”

Hoerr is an expert on the psychosocial and contextual factors that drive health behaviors. One of her recent research projects studied the relationship between family meals and the diet quality and weight of young children.

“There is increasing evidence that the prevalence of family meals influences diet quality in children, which suggested a relationship to obesity,” Hoerr explained. “There is evidence to suggest that kids who eat away from home by themselves make bad food choices.”

Working with the MSU College of Nursing and the Early Head Start Program in Jackson County, researchers surveyed approximately 200 Head Start parents with young children to see what types of foods were available to both parents and youngsters, which foods they actually consumed, who made the food choices, and how often parents and children ate together.

“More than 90 percent of this population is below the poverty level,” Hoerr explained. “Other research suggests that as income levels go down, food choices get less healthy. Parents influence what their children eat, so if they make better choices, their kids will make better choices.”

Hoerr’s data revealed that only 15 percent of the mothers (the heads of households in the survey group were predominantly single women) and 40 percent of the children were eating more than one serving a day from each of the five food groups. The mothers were low on dairy and fruit, and the kids were low on fruits and vegetables. And consumption of fruits and vegetables dropped as the children aged from 14 months to 3 years.

The data about the types of vegetables they were eating were even more troublesome.

“We asked, during three meals and three snacks per day, which vegetables did toddlers [2-year-olds] eat,” Hoerr explained. “We found that out of 118 kids, 58 of them ate potatoes, which is almost half. And they were usually in the form of french fries, which are high in fat and sodium.”

Green beans were the next highest, with 11 kids eating them, then corn, peas and carrots.

The scientists also asked about the amounts and types of beverages the toddlers were drinking per day. For milk, the average was about 12 ounces, which is good. But they were also drinking 9 ounces of juice per day, which is 3 ounces more than the American Academy of Pediatrics recommends. They were also drinking 7 ounces of soda per day.

“Seven ounces was the average amount,” Hoerr said. “That translates into 14 percent of 2-year-olds drinking more than a can of soda per day — at age 2.”

The scientists also examined the families’ eating environments, the first time this has been studied.

“Children should be seated while eating to reduce the risk of choking,” Hoerr said. “About 10 percent of the children were not seated while eating at all. They were in the bedroom, in the basement, in the laundry room — they were eating everywhere. Only 50 of 118 kids ate all three meals at the table.”

For breakfast most of the kids were seated, but after that most started roaming. More than half ate their snacks and dinner while watching television. Many parents allowed their children to leave the table after only 5 minutes and randomly snack on sugary foods, such as ice cream, throughout the rest of the evening.

“We found that children who ate their meals at the table had better diet quality than those who didn’t eat at the table,” Hoerr said. “Kids that were talking to their parents and siblings rather than watching TV or running around the house also had better diets.”

Research from focus groups with Head Start parents of 4-year-old children revealed that many times the 4-year-olds were deciding what they were having for dinner.

“Instead of a parent saying, ‘We’re having spaghetti for dinner,’ the parent asks the child, ‘What would you like to have for dinner?’ So the child is calling the shots,” Hoerr said.

If diet quality remains low, children may be on the road to obesity. In Michigan, 11 percent of children are overweight, a rate that has tripled in the past 30 years and is among the country’s highest.

A child who carries extra weight is usually facing a lifetime struggle. An overweight adolescent has a 70 to 80 percent chance of becoming an overweight adult. Being overweight at a younger age also means that the illnesses associated with obesity in adults — type II diabetes, high cholesterol, high blood pressure — can affect those in their teens and even younger.

Hoerr’s study is an important first step in mapping the relationship between family mealtimes and personal factors of adolescent weight status and diet quality.

“We know that what parents eat has an influence on their children’s diet quality,” Hoerr said. “And we know that eating meals as a family influences diet quality. All this affects children’s weight as they move into adolescence. If they have good eating habits then, they’re less likely to become overweight adults.”

“I’m not obese. He is.”

As its panel of experts works to revise national dietary guidelines and the food pyramid, the federal government’s best advice is to exercise at least five times a week, eat less fat and make carbohydrates part of a balanced diet.



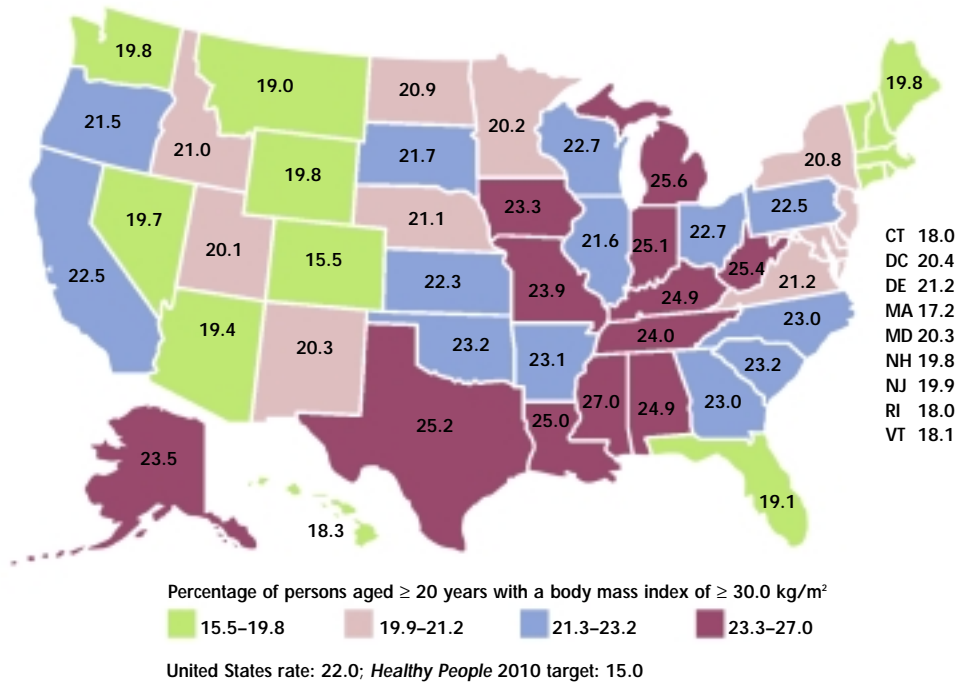
Sharon Hoerr, MAES food science and human nutrition scientist, is an expert on the psychosocial and contextual factors that drive health behaviors. She is studying the relationship between family meals and the weight of young children.



MAES nutrition scientist Beth Olson’s research has shown that Michigan residents view obesity as an issue of personal choice, not a public health problem. This may influence the success of state programs to combat obesity.

## Obesity Among Adults, 2001

Source: Behavioral Risk Factor Surveillance System, CDC.



People with high cholesterol should limit saturated fat calories to 7 percent of fat calories. Trans fats should make up less than 1 percent of daily calories.

- A drink of alcohol is OK, but women should limit themselves to one 12-ounce beer, a glass of wine or a shot of distilled spirits per day. Men can double those amounts.
- Eat three servings of whole grains daily and avoid refined grains.
- Eat three servings daily of low-fat dairy products such as skim milk or yogurt.
- Eat two servings of fish a week, for a total of about 9 ounces — especially fish high in omega-3 fatty acids, such as salmon.

The recommendations — with a new emphasis on exercise, fish and fiber — are part of a draft of dietary guidelines due out in January 2005. Although the draft hasn't been made public, highlights were released at the end of May about the new shape of the Food Guide Pyramid, the government's attempt to translate nutrition science into practical consumer advice. The dietary guidelines also influence federal food programs, including school lunches and food stamps.

### The highlights:

- Limit sedentary activities such as watching television and playing video games.
- Increase moderate to vigorous physical activity to at least 30 minutes five or more days a week. Children, teen-agers and adults with weight problems should increase that to 60 minutes.
- Instead of focusing on proportions of fats and carbohydrates in the diet, aim for overall balance and moderate calories based on these food groups: fruits, vegetables, whole grains, low-fat milk products, and lean meats or meat alternatives.
- Limit portion sizes.
- Eat a variety of dark green and orange vegetables and fiber-rich foods.
- Increase such nutrients as vitamins A, C, D and E, folate, calcium, magnesium, zinc and potassium.
- Limit fat intake to 20 to 35 percent of daily calories, generally limiting saturated fat to 10 percent of fat calories.

"The dietary guidelines are good," said MAES nutrition researcher Olson. "But broad guidelines may not be best for society as a whole. They're not personalized enough. People hear a lot about nutrition, and many of them are burned out, overwhelmed. There's just too much in the media for them to take in. Media coverage about this issue is huge, but there is no real consensus out there about what to do."

Olson should know. She has conducted surveys about how people view obesity in conjunction with the MSU Institute for Public Policy and Social Research (IPPSR) as part of the MSU State of the State Survey. In both 2002 and 2003, the surveys show that a majority of the state's residents see the issue as one of personal choice, not a public health problem.

"People are aware of obesity," Olson explained. "But they don't think the various factors that cause obesity apply to them. They're concerned about themselves, their spouses and their kids being overweight, but not people outside their families, such as friends or neighbors. They don't like punitive public health solutions, such as special taxes or higher health insurance premiums. They like more parks and more education, but that will require putting resources in those areas."

Slightly more than half of the respondents thought that they were overweight, and these people were more likely to see obesity as a personal choice issue. All the respondents were concerned about obesity and said they were concerned for health reasons, but they did not recognize the existence of barriers to healthy eating.

“There is a strong disconnect here,” Olson said. “We have to make it more applicable to people. Even if they classify themselves as overweight, they don’t think they’re obese — that’s someone else.”

Olson also asked about barriers to healthy eating and levels of physical activity.

“The responses to barriers to healthy eating were interesting,” Olson said. “In our work, we had identified time, cost, understanding of nutrition and eating alone as some of the barriers to eating healthy.

“But the results didn’t come out that way. People didn’t see lack of time or being too busy to prepare food as a barrier to eating healthy. And only 50 percent said cost was an issue. Either these barriers aren’t the most important ones, or people aren’t aware of the influence they’re having.”

Under the current guidelines for physical activity, the CDC recommends 30 minutes of moderate intensity activity five or more days per week or 20 minutes of vigorous activity three days per week. The Food and Nutrition Board of the Institute of Medicine recommends 60 minutes of exercise “most” days of the week, accumulated over the course of the day.

Survey results showed that most people thought that recommendations were to get physical activity three days per week for 30 minutes.

“I don’t think all these people are doing intense exercise three days a week,” Olson said. “This is another disconnect. People think that moderate exercise three days a week is enough. It’s not when the rest of the day is spent being very inactive.”

This is part of the reason why the new guidelines are recommending 30 minutes of moderate to vigorous activity five days per week and upping that to 60 minutes five days per week for overweight people.

Olson said most of the policies to address obesity are public health policies, such as the federal guidelines, which may explain why they’re not working. People don’t view the problem as a public problem.

“We have to give people the skill sets to make healthy food choices and make the environment more supportive for healthy eating and exercise,” she said. “It’s easy to talk about but harder to do.”

One environment that may be a good place to start is schools.

“In schools, it’s a little bit easier to make healthier food available and to support exercise,” Olson said. “You have a



According to Patricia Farrell, FACT associate director, MSU is the perfect place for obesity research because of the university’s expertise in basic and applied research in a range of disciplines.

captive audience, and there is already a learning structure in place.”

MSU Extension and the Michigan Department of Education have developed a tool that schools can use to assess their environments, looking at everything from the types of foods in vending machines to the types of rewards children liked the most. Ironically, pizza parties appear to be the most popular reward for excellence, but what kids value most is more recess time.

“This model helps schools assess what they have and decide what they want to change,” Olson said. “They don’t have to change everything — that would be very difficult. But if they can make one change, it will help. Prevention is key. It’s much easier to gain weight than to lose it.”

#### Partnering to Fight Obesity

Following a pattern of success established by the coalitions created around Michigan’s plant and animal industries, the MAES, MSU Extension, the Office of the Provost, and the Institute for Children, Youth and Families created the Families and Communities Together (FACT) coalition to give communities access to research results quickly and easily.

The FACT coalition was created to stimulate, facilitate and coordinate MSU’s research and outreach efforts related to the health and well-being of children, youth and families; to sup-



Dale Romsos, MAES food science and human nutrition researcher, is studying the mechanisms of body weight regulation using *ob/ob* mice as a model. The mice have a genetic mutation that gives them an extremely low metabolism. The *ob/ob* mouse is on the left and a normal mouse is on the right.

port and develop the capacity of Michigan communities to meet their own needs; and to encourage new directions in scholarship and new applications for problem solving.

In February, FACT sponsored an obesity forum attended by faculty members from across the university. Kimberlydawn Wisdom, Michigan's surgeon general, and Lou Anna K. Simon, MSU provost and president designate, were guest speakers.

Wisdom focused on organizing the university, the legisla-

tive community and the public to challenge obesity and overweight.

"We need to understand how serious this challenge is because throwing money at the problem will not make it go away," she said. "There needs to be a change of culture, people need to start thinking about a healthy life that includes three dimensions: healthy eating behaviors, physical activity and the elimination of tobacco."

Some recommendations that came out of the forum included holding regular conferences with recognized experts, developing training programs, aligning ideas with both the governor's and state surgeon general's initiatives on obesity, and connecting and communicating with colleges and departments throughout MSU.

"We have a FACT coalition work group on obesity that is following up on these recommendations," said Patricia Farrell, FACT associate director. "The consensus is that we need to have faculty and staff members representing a variety of disciplines when we're addressing obesity. MSU is the perfect place to do this because we have expertise in basic and applied research in social science, agriculture, molecular biology, medicine, nursing, land use and other disciplines, and we are in a position to help respond to this growing problem."

Acting as both a funding organization and a clearinghouse for obesity-related research and information, FACT has sponsored a number of projects aimed at obesity and health.

"For FACT to fund a project, the research team must be multidisciplinary," Farrell said. "FACT funds support pilot research, enabling the team members to position themselves to apply for larger grant funds to expand the study."

Some of FACT's recent projects include:

- "The Young Child Overweight Prevention Study." Researchers in the MSU departments of Pediatrics and Human Development, Kinesiology, Epidemiology and Nursing, as well as specialists from MSU Extension and the Department of Community Health, will conduct a survey of 180 mothers with children ages 1 to 5 years who have Medicaid insurance. Diet, physical activity and openness to behavior change will be assessed. They will use the results to develop effective messages based on theoretical models to prevent obesity among low-income mothers with young children.
- "Nutrition Education Aimed at Toddlers (NEAT)." Research has shown that good eating habits established in early childhood can lead to a lifetime of good health and nutrition. With a federal grant, MSU faculty and Extension staff members are now expanding a research-based nutrition education program to 23 Michigan counties to help parents of toddlers make healthy food choices.
- "Jump, Jive and Learn," a health and fitness program, was created and led by elementary and middle school principals in Kalkaska to help students apply health promotion

and disease prevention concepts to personal, family and community health issues. The initiative is part of a shared vision with the Michigan Department of Education to encourage students to use goal-setting and decision-making skills to enhance health.

- “Eat Healthy, Eat Breakfast,” a campaign aimed at increasing breakfast consumption among 11- to 15-year-olds in Clinton, Eaton and Ingham counties. The youth participants liked the program, and breakfast eating increased in the counties.

#### The Mechanics of Obesity

While a number of researchers are studying how to educate people effectively about obesity and develop ways to modify our mass consumption, other scientists are focusing on obesity at the cellular level. Why do certain people’s bodies store more fat than others? Why are metabolisms different? Is there one hormone or organ that controls weight?

Dale Romsos, MAES food science and human nutrition scientist, has studied the mechanism of body weight regulation for many years. Much of his work has focused on leptin (from the Greek word *leptos*, which means “thin”), a protein hormone.

“Leptin has a complex relationship to body fat,” Romsos explained. “It has to be this way for our survival. There are a number of systems that regulate body fat. If there were just one and it failed, we’d die.”

Leptin is primarily made in the fat cells of the body and acts on the hypothalamus to reduce food intake and increase energy expenditures. The larger the amount of fat, the more leptin produced, telling the body to slow down — it has enough fat stored to generate all the energy needed to function.

Leptin also has other functions. It is thought to trigger puberty (women who are too thin are not capable of supporting a pregnancy) and may be important in bone development.

In the hypothalamus, leptin inhibits certain neuropeptides, including one called neuropeptide Y (NPY), which exerts powerful control over eating. If a lab rat is injected with NPY, it immediately begins eating. If mice are given leptin, within minutes the amount of NPY released is decreased.

“In 1994, it was thought that leptin could be injected to control obesity in people,” Romsos explained. “However, it was then found that overweight people already had higher levels of leptin and appeared to be resistant to it. Most overweight people are not helped by leptin injections, but we’re not giving up on it. We want to understand what’s happening.”

In his research, Romsos has found that steroid hormones known as glucocorticoids, produced by the adrenal glands on top of the kidneys, can cause leptin resistance.

“The adrenal glands become more active as we become agitated or stressed,” Romsos said. “So as people get stressed, they produce more glucocorticoids, which make leptin less

effective. They also tend to eat more when they’re stressed.”

People in highly stressful jobs may find themselves gaining weight even though they may be eating the same foods (but perhaps more of them).

Working with a pharmaceutical company, Romsos is attempting to find a compound that would block glucocorticoids’ effect on the body.

“The hypothesis is that this would make the leptin more effective,” he said. “But the whole relationship is far from totally understood. Our challenge is that glucocorticoids do good things — blocking all of them would be bad for health. We may be able to selectively block the glucocorticoid receptors in the hypothalamus that control the leptin effect.”

Romsos is also studying how obesity develops, using *ob/ob* mice as a model. The *ob/ob* mice have a genetic mutation that prevents the production of leptin, causing them to have an extremely low metabolism and become severely obese. The



*The new federal dietary guidelines to be released in January 2005 advise people to eat a variety of dark green and orange vegetables and fiber-rich foods.*

mice are born with normal body weight and become overweight as they mature.

“It’s impossible to follow people from birth to adulthood,” Romsos said, “tracking everything they eat and how much they weigh. But we can follow the mice.”



The effect of fatty acids on gene expression is the research focus of Don Jump, MAES physiology, biochemistry and molecular biology scientist.

Romsos and his colleagues looked at the intake of milk and food by the mice, as well as their metabolic rate and hormonal levels.

“We found that the first change in *ob/ob* mice was a lower metabolic rate with normal food intake,” Romsos explained. “The plasma insulin response was higher than normal when they ate, so more of the calories were being directed to be stored as fat, rather than used for energy. Leptin has a direct effect on the pancreas, which produces insulin.”

Romsos said there have been a few studies that looked at children who had overweight parents and children that had average weight parents.

“It was only after the children ate that any differences were seen in the children,” he explained. “A significant percentage of children with overweight parents had a higher plasma insulin response to a meal. The assumption is that this is genetic, but it is very suggestive of what we’ve seen in the mice.”

This may allow people to be screened for predisposition to obesity, allowing them to change their eating environments early on to prevent gaining weight.

“It’s much easier to prevent gaining 10 pounds of weight than it is to actually lose 10 pounds,” Romsos said. “Prevention is essential. That’s what we want to find.”

#### Fat’s Effect on Cells

Like Romsos, Donald Jump, MAES physiology, biochemistry and molecular biology scientist, is studying the mechanisms of obesity at the cellular level. Jump’s research focuses on fatty acid effects on gene expression.

“Dietary fat has two roles,” Jump said. “It functions as a source of energy and structural components for cells, and it regulates the expression of genes that affect lipid, carbohydrate and protein metabolism, as well as cell growth and differentiation.

“It turns out that glucose, fatty acids and cholesterol all have an effect on cells at the genome [the collection of all the genes in a cell] level,” he continued. “They control gene transcription [part of the mechanism of gene expression] and the metabolism of nutrients by the cell.”

By understanding how fatty acids regulate gene expression, Jump hopes to better understand the role that dietary fat plays in human health and the onset and progression of diseases such as coronary artery disease, atherosclerosis, obesity, diabetes, cancer, depression and schizophrenia.

“I started studying fat for two reasons,” Jump said. “One, because it was an underdeveloped area. There was little known about how fat regulated cell function, even though fat is responsible for several chronic diseases. Secondly, Michigan is No. 2 in the country in obesity, and we’re also in the top 10 for people with diabetes related to fatness. Twenty percent of obese people become diabetic, which is a large number of people. Plus, there are a number of secondary problems related to fat.”

There are four major types of fatty acids in people’s diets: saturated fatty acids, monounsaturated fatty acids, and n6 and n3 polyunsaturated fatty acids. It has been well-documented that saturated fats are unhealthy and make the body produce more cholesterol.

“Some fats are beneficial and some are not,” Jump explained. “Everyone needs some fat in their diet. Saturated fats are bad for you, while n3 polyunsaturated fats are good for you. These are found in canola oil and in the omega 3 fatty acids in cold-water fish, such as salmon. But we don’t eat a lot of those types of fats.”

The n3 fatty acids play a role in retinal and cognitive development. People with little or no n3 fatty acids have impaired vision and are slow learners. N3 fatty acids are also anti-inflammatory; n6 fatty acids promote inflammation.

“From your body’s perspective, you want to balance the n3



and the n6 fatty acids,” Jump said. “In the past five years, there has been some research suggesting that dietary fat may play a role in schizophrenia and depression. There is speculation that these conditions are related to cellular inflammation.”

Jump’s research looks at how the fatty acids bind to and regulate the activity of nuclear receptors that affect cell metabolism and signaling mechanisms. Several transcription factors, proteins that bind to DNA and initiate or inhibit the expression of a gene, have been shown to be regulated by various fatty acids.

“N3 fatty acids increase lipid oxidation by promoting fatty acid oxidation, meaning the body is using more fat — it’s clearing it out,” Jump said. “Fat needs to be turned over rapidly — you don’t want it to accumulate. If you don’t have this dynamic turnover, trans fatty acids [saturated fats] cause weight gain and plug up the body, causing diseases such as atherosclerosis. Our understanding of these pathways is recent, and there are still quite a few unanswered questions. As we better define the pathways, it may lead to the development of new strategies to fight obesity and associated chronic diseases.”

#### Bringing Healthy Food to All Communities

Experts point to a lack of competitively priced fresh produce in urban area grocery stores as a contributing factor to obesity. If the lettuce, cucumbers and tomatoes at the local grocery store cost \$7 and are wilted and brown, it is no wonder that a \$4 “super deal” meal at a local fast food outlet is the meal of choice for many.

Or there may not even be a local grocery store.

During the early 1980s, supermarket chains in the United States left inner cities and low-income areas for the suburbs. Major reasons cited for these moves by the food industry include high insurance rates, employment and security problems, and outmoded and understocked inner city stores that kept profits low. So the grocery stores have closed, replaced by convenience stores that carry a limited supply of canned goods, salty snacks and candy. Studies have shown that prices at neighborhood markets can exceed those at chain supermarkets by as much as 76 percent. A USDA report found that smaller stores also are unlikely to offer the variety of products carried by most major supermarkets. In a 1993 study in eastern Pennsylvania, researchers found that the average full-service supermarket offered 19 varieties of fruit, 29 varieties of vegetables and 18 types of meat, while the average small store only carried six types of fruit, five vegetables and two types of meat. The study also showed that the produce and other foods offered in smaller stores were often lower in quality.

As holder of the C.S. Mott Chair for Sustainable Agriculture, MAES scientist Mike Hamm works to support people and communities as they develop sustainable, community-based food systems.

“I view our group, which includes scientists and outreach



MAES scientist Mike Hamm holds the C.S. Mott Chair for Sustainable Agriculture. One of his research projects is studying whether people can get food from local sources.

professionals, as synthesizers,” Hamm explained. “We bring together producers and consumers at the community level to create sustainable agriculture from all standpoints: ecologically, socially and economically.”

One area the Mott group focuses on is ensuring that all members of a community have equal access to healthy food.

“One project is studying the question of whether people can get food from local sources, what that would do to the economy and the food supply,” Hamm said. “Michigan is sec-

ond in the country in agricultural diversity, and if you model what Michigan growers produce, it's about 100 percent of what the state's population needs.

"A very small percentage of Michigan products are direct-marketed," he continued. "It takes only about 40 percent of the state's acreage to feed Michigan's population. If we can improve the relationships between growers and consumers, we may be able to develop some new markets."

Out of \$16 billion to \$20 billion spent on food in 2000 in Michigan, about half was spent away from home, creating opportunities for Michigan producers marketing to restaurants, schools and other institutional food services.

Hamm envisions creating programs that serve the state's urban locations. To begin, he wants to determine the types of produce that residents in urban areas want and need. Are certain types of vegetables and fruits more desirable than others? Can local producers grow these preferred foods and get them to market in a timely manner? Is there an existing local market? These are all questions that need to be answered to



*The economic and social costs associated with an unhealthy population have a dramatic impact on Michigan's ability to compete in the 21st century economy.*

begin building the relationships.

"We need to bring together these tremendous purchasing and production powers," Hamm said.

#### Prescription for a Healthier Michigan

In May, Gov. Jennifer Granholm and Surgeon General Wisdom unveiled a plan designed to improve the long-term health of Michigan's citizens by focusing on strategies to prevent disease and other chronic health conditions.

"The economic and social costs associated with an unhealthy population have a dramatic impact on Michigan's ability to compete and succeed in the 21st century economy," Granholm said. "If we are to attract new businesses and create jobs, we have to have healthy, productive workers. Dr. Wisdom's 'Prescription for a Healthier Michigan' will help us start down the path to better health."

"Personal choices and commitment ultimately will make the difference in our individual health and the well-being of our communities," Wisdom said. "Unless we all take greater responsibility for ourselves, our families and our communities, Michigan's collective health will not improve."

In "Prescription for a Healthier Michigan," Wisdom outlines strategies that Michigan's healthcare, business, educational, and faith-based communities should enact to ensure a healthy population.

Among the highlights:

- Business and industries should provide healthcare benefits that support prevention activities, encourage and establish incentives to use such benefits and develop health-based partnerships with community-based organizations.
- K-12 schools should adopt policies on healthy foods and beverages, implement 24-hour, seven-day-a-week tobacco-free policies, and integrate health education and physical education into school curriculums.
- Healthcare providers should offer prevention services for all patients, educate and support patients in maintaining health and self-management of diseases, identify populations to reduce health disparities, and play a substantial role in community efforts to advance and promote healthy lifestyles.
- Colleges and universities should prepare health professionals to respond to the needs and challenges of the 21st century through comprehensive professional training programs, and recruit and retain diverse health professional workforces to address urgent health issues facing Michigan citizens.

∴ Jamie DePolo

# Former Foster Children and Leadership in the Child Welfare System: The Power of Experience

As a foster child, MAES scientist John Seita experienced the flaws of the system firsthand. As an adult, he is working to change it and make MSU a national leader in this important policy area.

**T**he U.S. statistics are staggering. At any given time, more than 600,000 children in the child welfare system are placed in out-of-home status. More than 25,000 children make the transition from foster and other dependent care settings every year, perceived and classified no longer as children but as young adults, no matter that they may not be ready to make this change.

- Children in foster care make up less than .003 percent of the nation's population, but 17 percent of state prison inmates are former foster children.
- Forty percent of foster children leaving the child welfare system join the country's welfare rolls.
- Of the children moving out of foster care, only 4 percent attend college, and half of those drop out before completing their degrees.
- In Los Angeles County, 39 percent of the homeless youth are former foster care children.

In an evaluation of foster care independent living programs done in 1991 and 1992, Ronna Cook, associate director of Westat, Inc., a company in Rockville, Md., that conducts research and program evaluation studies for government agencies and corporations, found:

- 66 percent of 18-year-olds had not completed high school or earned a GED.
- 61 percent had no job experience.
- 38 percent had been diagnosed as emotionally disturbed.
- 17 percent had a drug abuse problem.
- 90 percent had a health problem.
- 17 percent of the women were pregnant.
- 40 percent had held a job for at least one year.
- 60 percent of the women had given birth.
- 25 percent had been homeless for at least one night, and fewer than one in five were completely self-supporting.



“The outcomes of the child welfare system are appalling,” said John Seita, MAES social work researcher and former foster care child. “There seem to be few remedies and even fewer effective and concrete strategies to fix what we have unleashed in the child welfare system.”

**S**eita knows what he is talking about. He was removed from his mother’s home when he was 8. He was abused and neglected as a child, and his journey through children’s institutions and countless foster homes was a litany of degradation and humiliation. His unrestrained anger at his mother and the system led to a childhood of anger, loneliness, and fighting with adults, counselors, teachers, house parents, childcare workers and anyone else who crossed his path. Today, even after completing his doctorate, writing three books — the most recent is *Kids Who Outwit Adults* — and serving on the lieutenant governor’s statewide Commission on Children under Gov. John Engler, he considers his relationship with his wife, Lori, and their daughter, Anorah, his proudest accomplishment.

According to data from the Administration for Children and Families, a division of the U.S. Department of Health and Human Services, the number of children in out-of-home placements has steadily increased over the past 20 years.

Seita said that family preservation programs — programs that provide intensive in-home support services — have emerged as one attempt to keep families together and to keep children out of the child welfare system. Wrap-around programs are another attempt to reform child welfare. Wrap-around programs help families establish goals and then achieve them. Kinship care is another effort to keep children within their families.

“However, in spite of these efforts, the child welfare system continues to limp along at best,” Seita said. “I think it’s time to consider some new approaches.”



MAES scientist John Seita (*above, center*) organized the Pathways to Leadership conference on the MSU campus in May. The select group of participants from around the country spent the day discussing the issues and challenges facing former foster children. Attendees included Millicent Williams, of the Child Welfare League of America, (*left*) and Dr. Martin Mitchell, CEO of Starr Commonwealth (*above, far right*). One of Seita’s research projects focuses on including child welfare system alumni in leadership and advisory roles in the system.

### The Power of Experience

Seita’s research is looking at two related areas that may better the child welfare system and, subsequently, the children in it. In the first, he is examining the factors that affect foster children as they make the transition from the foster care system to independent adult living and how their needs differ from those of children who are not in foster care. The second area, which dovetails seamlessly with the first, focuses on including child welfare system alumni in leadership and advisory roles within the system.

As part of this work, he recently completed a survey to discover how many

child welfare alumni are in leadership positions in child welfare agencies across Michigan. Conducted in partnership with the Michigan Federation for Children and Families, the study found that only about six agencies out of 104 had board members who were child welfare alumni. No agencies reported having either a chief executive officer or any executive staff members who were child welfare alumni.

“This survey suggests that about 90 percent of child-serving organizations have no policy input from the people who were consumers of their services,” Seita explained. “This is much different from other agencies in the country. I believe



about 90 percent of the leadership positions in the Bureau of Indian Affairs are held by Native Americans. When the Gallaudet University Board of Directors tried to appoint a hearing person as president of the university, the students, alumni, and faculty and staff members staged a weeklong protest and demanded that someone hearing impaired be named president. I. King Jordan, an alumnus of the Gallaudet, was ultimately named president.

"I think part of the problem with the child welfare system may be that few of those administering and leading the system have experienced the system as a con-

sumer of services," he said. "It's hard to imagine the system being legitimate without input from people who have been through it."

Seita uses a scene in the movie "Good Will Hunting" to illustrate his point.

"In the movie, Matt Damon, as Will, is talking to his therapist, Sean, played by Robin Williams. The therapist says, 'You're an orphan, right? Do you think I'd know the first thing about how hard your life has been, how you feel, who you are, because I read "Oliver Twist"?' Does that encapsulate you?' This scene very poignantly demonstrates that there is a difference between living the experience and studying the

experience. The evidence to date suggests that unless child welfare system alumni are included in genuine decision-making, advising and leadership roles at child welfare agencies, a crucial body of expertise is being ignored."

The question then becomes how to engage child welfare system alumni and get them involved in the system in leadership and advisory roles. That circles back to Seita's other research area.

"Foster kids need the same things that all kids need," Seita said, "safety, love, opportunities. We just have to be more intentional about providing them and more strategic in our delivery. And they may need larger quantities of all these things."

**B**ecause many foster children have been in hurtful situations, they are mistrustful of and often hate adults. They lack the basic navigation skills that most children reared out of the child welfare system take for granted, such as what tipping is and how to do it, how to make a long-distance telephone call, or what types of foods are healthy and how to plan a meal. They have a hard time accepting help and care from other people because they do not feel that they "belong" to those people and cannot take anything from them.

"We have to be more intentional in providing and demonstrating love and opportunities to these kids," Seita explained. "They have no sense of family privilege, no sense that they are entitled to anything. Across the board, there are lower standards for foster kids, so they are not nurtured to be leaders. People don't think they can do it, so the kids are never thought about in that way or given leadership opportunities. The standard of success is so low that just staying out of the system is considered a huge success, never mind achieving other goals.

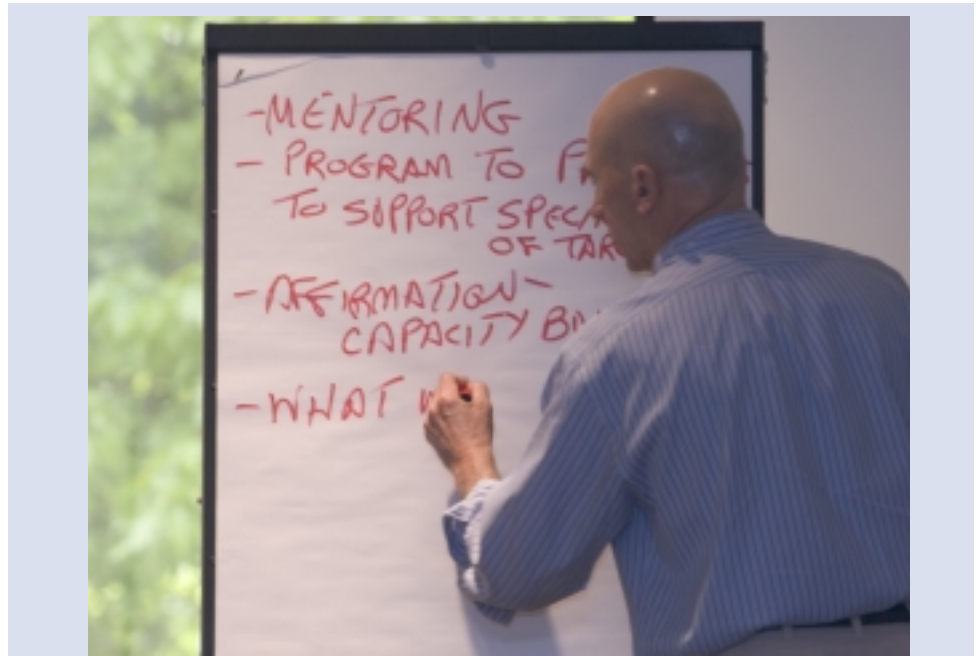
"People don't see that skills are contextual," Seita continued. "If you put kids in the same context that spit them out, of course they're going to go right back in. We

need to humanize success for these kids and give them role models so they can see people like them and then envision themselves being successful.”

### Creating Leaders

To offer foster children role models as well as a way to move into leadership positions, Seita organized a conference, “Pathways to Leadership” May 18 at the Kellogg Center on the MSU campus. The select group of participants from across the country spent the day discussing the issues and challenges facing former foster care children in making the transition to college, as well as the idea of a leadership academy for foster care children and alumni and the policy issues surrounding foster care. His goal, besides creating a pipeline of well-educated former foster children to serve the system, is to inject more science into the child welfare system. Seita is well connected and well respected in the child welfare system. He worked for five years as a program director for the W.K. Kellogg Foundation, in Battle Creek, and was director of program evaluation for the Kalamazoo County Human Services Department, program administrator for the Calhoun County Community Mental Health Department, and a research associate and adjunct professor at Western Michigan University. He has also been a youth worker in several treatment settings.

“We haven’t made the system a science,” Seita explained. “When it comes to foster kids and welfare recipients in general, we have this whole mentality of ‘you have to pull yourself up by your bootstraps, no one can do it for you.’ But we’re being blinded by our own contexts here. We need to be intentional about understanding the context of foster kids. They don’t have the tools that others have. Yes, they make choices, and many of them are bad, but what needs to be understood is that they don’t have the same map of choices that most young people living in typical homes have. For them, the choice may be starving or stealing food, so they steal. A bad choice, definitely, but they don’t see that they have any other choices.



Seita’s goals for the Pathways to Leadership conference were to inject more science into the child welfare system, as well as to create a pipeline of well-educated former foster children to serve the system. Bill Schroer, of the W.J. Schroer Company, above, served as moderator.



We need to understand that context and make sure that foster children have access to all the tools that come with family privilege.”

The May conference was the first of its kind, and Seita sees the issue as an opportunity for MSU.

“This program is unique at MSU — we have the potential to change the pathways

to leadership in the child welfare system and bring about policy changes,” he said. “At MSU if you have a good idea, you’re allowed to be innovative. I’m tremendously excited about the potential of this program and the opportunity to make MSU a national leader in this area.”

... Jamie DePolo

# Research *in the news*

## MAES Director Named MSU Research Vice President

J. Ian Gray, director of the Michigan Agricultural Experiment Station (MAES) and a veteran at guiding research at Michigan State University, is the university's new vice president for research and graduate studies.



The appointment of Gray, who is also interim vice provost, was approved July 22, by the MSU Board of Trustees. Gray succeeds Robert Huggett, who had been vice president since 1997.

His appointment began Sept. 1.

"Ian Gray has a long and distinguished record of guiding a great research program here at Michigan State," said MSU President Peter McPherson. "His creativity and vision will continue to enable us to craft productive partnerships both on campus and across the world. His accomplishments as an administrator and as a scientist are impressive, and we are pleased he is with us to keep the tremendous momentum MSU's research has."

In his 17-year tenure in the MAES, which encompasses the work of more than 300 scientists in five colleges at MSU, Gray has been a driving force behind the expansion of interdisciplinary research, which now is a cornerstone of MSU's vision to advance knowledge and transform lives through exploration and discovery.

"Ian Gray is a great choice to build MSU's research portfolio," said Lou Anna K. Simon, MSU president designate and provost. "He has a tremendous network of support, not only across the university, but nationally and internationally. Michigan State is a research-intensive university with a passion for advancing knowledge and transforming lives.

"Under Ian's leadership, MSU will continue to confront some of the world's most complex and perplexing problems. We'll play a vital role in enhancing the quality of life for individuals and will continue to be a driver for the economic

growth of our state and the region."

Gray, 59, a food scientist expert in the formation of toxic compounds in foods as a result of processing and cooking, came to MSU in 1978 as an assistant professor of food science and human nutrition.

In 1987, he became acting assistant director, and a year later associate director of the MAES, which generates knowledge through strategic research to enhance agriculture, natural resources, families and communities in Michigan.

In that position, his primary responsibilities included managing the multi-state research program and developing and maintaining strong ties between MAES researchers and the state's commodity groups. He promoted multidisciplinary efforts to address problems identified in state assessments of Michigan agriculture and natural resources. He also worked to facilitate special U.S. Department of Agriculture grants on fruit quality, sustainable agriculture, and potato breeding and quality.

Gray became MAES director in 1996 and assumed the additional duties of interim vice provost in 1998 and of assistant vice president for research and graduate studies in 2000. He has expanded the mission of MAES to include more research in the social science areas and helped bring the National Food Safety and Toxicology Center to MSU.

"Not only have we maintained our commitment to the traditional charge of serving the state, but the Agricultural Experiment Station has maintained a multidisciplinary approach that has engaged many faculty members that don't have traditional links," Gray said. "We've used the MAES to engage a major part of the university research machine, and that is very powerful."

"Ian Gray's 26 years of dedicated service to MSU as a research scientist and director of the Michigan Agricultural Experiment Station have prepared him well for this new role," said Jeffrey Armstrong, dean of the College of Agriculture and Natural Resources. "He is an effective and strategic administrator who has aggressively expanded the MAES research agenda across campus, particularly in the social and behavioral sciences. I am very pleased that his vision and creativity will now help

inform and shape the broader research mission of the university."

Gray has been an active bench scientist with a body of research that contributes to safer, more healthful food and also assists in developing Michigan products. He lists 170 scientific journal publications and 120 papers presented at scientific meetings. His work includes such high-profile projects as MSU's findings that show that tart cherries have healthful antioxidant properties.

Gray, a native of Northern Ireland, received his doctoral degree in food science from Queen's University in Belfast, conducted post-doctoral research at MSU and was an assistant professor of food science at University of Guelph in Ontario, Canada.

"It's a wonderful honor to be appointed, and I look forward to the work of enhancing the research excellence at MSU and putting together a university-wide research agenda that will do justice to the research talents that exist at MSU," Gray said. "I also look forward to working closely with Graduate School Dean Karen Klomprens to make graduate research and training an even more rewarding experience for students at MSU."

## Land Policy Program Announces 44 Grant Awards

The Michigan State University Land Policy Program announced 44 grant awards totaling \$680,000 to researchers and outreach faculty members at MSU, Wayne State University and the University of Michigan for projects that protect land resources, encourage smart growth and revitalize urban centers.

Grant projects include measuring the success of brownfield redevelopment programs, creating and measuring success in municipalities participating in Gov. Granholm's Cool Cities initiative, assessing the effectiveness of state property tax abatements, and training entrepreneurs to support reopening a farmers' market to provide produce to a Detroit neighborhood with no grocery stores.

Other projects will assess demographic trends and infrastructure costs on urban sprawl, model the effects of aspen forest management practices on wildlife and habitat, and stimulate the development of

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a recreational trail network in the eastern Upper Peninsula.

“We want these grants to kick-start a vigorous multidisciplinary, statewide strategy to reward innovative research and effective outreach proposals that support the development and implementation of smart growth across the state and the Great Lakes region,” said Soji Adelaja, the John A. Hannah Distinguished Professor in Land Policy and MAES-affiliated scientist, who heads the newly created Land Policy Program.

Grants range from \$2,000 to \$150,000. A review panel selected 44 projects for funding from 80 proposals in eight categories: rapid response, outreach and capacity building, program planning, program implementation, research and outreach equipment, special projects, graduate research scholars, and undergraduate research scholars.

The Land Policy Program was established to strengthen and expand MSU’s commitment to the use of science for addressing public policy and community needs. It provides university research and delivers statewide outreach on critical land use issues. The new program fosters collaborative relationships with university departments and other colleges and universities to create multidisciplinary teams to solve local, regional and statewide land use problems.

## Northwest Station Celebrated 25th Anniversary in August



Over the past 25 years, the Northwest Michigan Horticultural Research Station has helped Michigan cherry growers maintain their position as the country’s top cherry-producers.

“We have developed a worldwide reputation for cherry research,” said Bill Klein, farm manager. “The northwest Michigan fruit industry looks to the station for research on integrated pest and crop management concepts.”

In 1978, a group of fruit growers from the counties of Manistee, Benzie,

Leelanau, Grand Traverse and Antrim formed the Northwest Michigan Horticultural Research Foundation to establish a field research station in the area because other MSU research facilities did not represent the unique climate and soils of the state’s northwestern and west central growing areas.

After a fund-raising campaign, the foundation purchased an 80-acre farm near Bingham in Leelanau County in November 1978. By the next summer, an office and storage facility had been built on the site. An open house in September 1979 marked the official start of operation at the station. The MAES then leased the facility and property from the foundation.

“Cherry research is one of our top priorities,” Klein said. “The station pioneered efforts to disseminate real-time information during the growing season via fax and e-mail. This has helped growers minimize pesticide use and enhance profitability.”

Other research includes sweet and tart cherry variety and rootstock evaluations, management trials of sweet cherries on dwarfing rootstocks, orchard floor management trials, cherry nutrition studies, evaluation of new reduced-risk chemistries for insect and disease management, alternative fruit and nut crop evaluation, enhancing fruit quality, insect biology, trapping and pesticide alternatives.

During the 2004 National Cherry Festival in July, more than 1,700 people visited the Northwest Michigan Horticultural Research Station in Traverse City, said Jim Nugent, station coordinator and MSUE district horticulture agent.

On Aug. 26, the station opened its doors to officially celebrate its 25th anniversary. Tours of the station and poster sessions by MAES researchers highlighted the event.

“This station brings together a unique blend of MAES research and Extension programming combined with the active participation of the fruit industry and excellent support from MDA,” Nugent said. “This station puts the university at the focal point for information for both northwest Michigan’s fruit industry and the tart cherry industry throughout Michigan, North America and the world. There is a great sense of pride and sup-

port from the fruit industry in the research and outreach activities conducted at the Northwest Michigan Horticultural Research Station.”

## Grape Growers to Have Added Access to Scouting Information

Michigan juice and wine grape growers can reduce pesticide costs and protect the environment by scouting their vineyards for early signs of insect and disease infestations. A recently funded Michigan State University research project will help them improve their pest scouting techniques and catch potential problems before they get out of hand.

The two-year research project, funded by the American Farmland Trust and the Pesticide Environmental Stewardship Program, is intended to increase the use of scouting by Michigan juice and wine grape growers by making the latest scouting information available through multiple sources. The initiative will also support various MSU Extension grape grower workshops and on-farm scouting demonstrations, including integrated pest management (IPM) programs that will evaluate how effectively new products perform in commercial settings.

“This research project allows us to focus on increasing grower knowledge of the insects, diseases, vine disorders and weeds that can challenge the production of quality grapes,” said Rufus Isaacs, project leader and MAES entomology researcher. “We hope that learning how to accurately identify these problems and the natural enemies that live in the vineyard better positions growers to make informed vineyard management decisions.”

Because no two vineyards are alike, scouting helps to ensure that problems specific to individual sites are detected and identified before they reach economically damaging levels.

“When scouting a vineyard, growers look for developing problems and their sources,” explained Joy Landis, MSU assistant IPM coordinator. “Correctly identifying a problem allows the grower to apply the appropriate pesticide or implement the proper management tactic at the optimum time.

“Scouting helps growers avoid apply-



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ing unnecessary pesticides because applications are made only when economic damage is likely to occur,” she said. “Both the environment and the grower’s bottom line are best served when pesticides are used as judiciously as possible.”

As part of the project, growers will be able to access weekly scouting summaries from vineyards in the primary grape-growing regions of the state on the MSU grape Web site: [www.grapes.msu.edu/](http://www.grapes.msu.edu/).

## **Agricultural Economics Project Is Finalist for Development Foundation Prize**

With an MAES scientist as one of its leaders, a Michigan State University project that provides farmers and traders in Mali with nearly real-time market reports is a finalist for the Petersberg Prize.

The Agricultural Economics Department’s Mali Market Information Project was named one of eight finalists for the Development Gateway Foundation’s prize. The prize is awarded for the most exemplary application of information and communication technology in the developing world over the past decade.

The Mali project, known by its French acronym PASIDMA (Projet d’Appui au Système d’Information Décentralisé du Marché Agricole) has helped Mali’s agricultural market information system (MIS) provide farmers and traders with nearly real-time information on prices and other market conditions for their crops and livestock.

The technological heart of the system is a solar-powered computer network that links local MIS offices across the country through e-mail sent over high-frequency radio. The local MIS offices are in turn tied to local private radio stations that broadcast market reports in French and local languages.

PASIDMA is a joint effort of MSU’s Department of Agricultural Economics, USAID and the Permanent Assembly of the Chambers of Agriculture of Mali (APCAM), and is implemented under the USAID/MSU Food Security III Cooperative Agreement. John Staatz, MAES agricultural economics scientist, and Niama Nango Dembéle, visiting assistant professor of agricultural eco-

nomics, led the effort for MSU in partnership with Abdramane Traoré of APCAM.

## **Emerald Ash Borer Web Site Introduced**



To provide Michigan residents with the most up-to-date information on the emerald ash borer (EAB) infestation and control methods, the EAB task force has created a Web site at <http://emeraldashborer.info/>.

The site is a collaborative effort of the USDA Forest Service, the Michigan Department of Agriculture, Michigan State University, the Michigan Department of Natural Resources and the USDA Animal and Plant Health Inspection Service (APHIS) to provide comprehensive, accurate and timely information on the emerald ash borer to the site’s visitors. Support from the USDA Forest Service and the MDA enabled creation of the site, which is administered through MSU.

MAES forest entomology scientist Deb McCullough and MAES entomology scientist Dave Smitley are conducting research on controlling the pest.

## **Spartans go to the Olympics — Not on the Field, but with the Field**

MAES know-how brought a little myth-like magic to the summer Olympic games.

It sounds like something Zeus could cook up — a field of lush, sturdy turf springing up where acres of asphalt once stood. MAES turf scientists helped the Olympics create a portable athletic field within four days.

The portable field is another generation of MSU expertise, the offspring of the first indoor pitch for the 1994 World Cup at the Pontiac Silverdome and the movable field in MSU’s Spartan Stadium.

John N. “Trey” Rogers, MAES crop and soil sciences researcher, said this time the scientists were challenged with the Olympics of turf science — moving

approximately 6,000 modules of turf into the Olympian stadium after the Aug. 13 opening ceremonies to be ready for the games to begin Aug. 17.

High-level security added to the challenge.

“The difference this time was that it was an opening ceremony that drove the job,” Rogers said. “But a portable field clearly was the solution, and people have gained confidence in us.”

Like Spartan Stadium, the Olympian Stadium has a sunken floor. MSU experts — including James Crum, MAES crop and soil sciences researcher — worked for months designing root zones and recommending appropriate grasses — Bermudagrass seems to be the best — that are tough enough to withstand the rigors of soccer and field events as well as the scorching Greek summers.

Graduate student Matt Anderson traveled to Greece April 20 to assist in field construction in a remote area similar to Spartan Stadium and stayed through the games to oversee the move-in details. Tim VanLoo, a senior, joined Anderson in late June to assist in a practice run of moving modules into the stadium. VanLoo returned to Athens in August. Rogers went to Athens in June as well.

The MSU team worked with GreenTech, the module manufacturer from Richmond, Va., which is a consultant on the project.

“It was important that this field perform for the games, obviously, but this field is staying in the stadium after the Olympics,” Rogers said. “This will be the stadium field for the nation.”

## **Nation’s Plant Database Falling Behind, Survey Shows**

Stopping to smell the roses may be laudable, but more people need to be picking, preserving and cataloging them.

Smelling doesn’t build and maintain a rich and necessary documentation of the nation’s biodiversity. A drop-off in collecting plants threatens the flora database that is the primary source of material for gardeners, county Extension agents, nature enthusiasts, artists and illustrators as well as medical scientists, forensics experts, law enforcement agencies and other scientists.

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The problem: collecting local or in-state plant life is in steep decline at a time when habitat is changing dramatically.

“To protect the best remaining native forests and to determine how development can best reflect our values, we have to thoroughly understand our natural heritage,” said Alan Prather, MAES plant biology researcher and plant curator at Michigan State University. “This information has to be kept current because new invasive species are introduced every year, and once pristine habitats are destroyed by both natural and human forces.”

Prather and Carolyn Ferguson, of Kansas State University, have outlined the trend toward doing less collecting, which holds true across the board, from the vast holdings of the Field Museum in Chicago to smaller plant museums that house only a few thousand specimens.

Their article, “The Decline of Plant Collecting in the United States: A Threat to the Infrastructure of Biodiversity Studies,” and the accompanying “Commentary: Implications of the Decline in Plant Collecting for Systematic and Floristic Research” appeared in the spring 2004 issue of *Systematic Botany*.

The researchers surveyed small and large collections of plants (herbaria) from public and private institutions, universities, museums and botanical gardens in 30 states and the District of Columbia.

Their findings are startling: fewer scientists and students are going into the field to gather plants and preserve them in collections. The result, Prather said, is not only a breakdown of resources for a myriad of professionals but also a breakdown of knowledge of what habitats were like and how they are changing.

It is vital to understand the composition of a natural habitat and to be able quickly to recognize the invasion of exotic species.

“If we cannot keep out such invading species, then our best defense is to detect them right away and eliminate them,” Ferguson said. “But unless we are vigilant and collect plants locally and know when invaders appear, we cannot possibly defend against them.”

Plant collections play an active role in medical and public health and forensic

science, Prather said. For example, if a child eats an unknown plant, workers in herbarium collections get the emergency call to identify the plant quickly.

“We need actual specimens to identify plants and, in a situation like this, to rule out poisonous possibilities,” Prather said.

In relation to national security, herbarium collections are assuming added meaning, the authors said. Without extensive plant reference specimens, identifying foreign plant diseases or pathogens of crops or forests would take much longer, Prather said, and meanwhile, serious damage could result.

Ferguson and Prather advocate increasing the resources for local collecting and for accessioning specimens.

“We need more people to do the actual collecting. We need to train students in collecting practices,” Prather said. “We need to focus on statewide plant collecting again and actively resist pressures to stop adding locally collected plant specimens to the nation’s herbaria.”

## MAES Scientists Bring Living Roof to Campus



At the end of May, Clayton Rugh, MAES crop and soil sciences researcher, and Brad Rowe, MAES horticultural researcher, helped MSU go greener — they oversaw the installation of a vegetative green roof on a portion of the Plant and Soil Sciences Building.

It’s much like the green roof that Rugh and Rowe helped design for the Ford Motor Company’s River Rouge Complex in 2000. On a specially developed base, they laid 200-pound rolls of sedum that will grow into a living, flowering carpet. At 10.6 acres, the Ford green roof is one of the country’s largest and is being closely monitored by the researchers.

Such a roof requires less maintenance than shingles or asphalt sealant and it doesn’t need to be mowed or weeded.

The green portion of the MSU roof will

be about 3,500 square feet; the rest was left covered with conventional materials for research purposes.

“The green roof is an ecologically beneficial technology,” Rugh explained.

The cutting-edge technology offers urban areas an attractive way to:

- Reduce airborne pollution.
- Reduce storm water runoff, a major problem in dense urban areas, by more than 60 percent.
- Moderate temperatures for both the building that sports the roof and those around it, reducing the so-called urban heat island effect.
- Reduce noise.
- Increase roof durability and longevity.

“Green roofs look great, but if this were just purely aesthetic, it wouldn’t fly,” Rugh said. “These additional benefits of green roofs will recoup their cost and pay for them.”

The new roof planting at MSU — on the southern two-story section of the building over the horticulture preparation area and Sparty’s Flowers floral shop — will be an effective on-campus lab, visible from the main building.

The living roof system is composed of a 2-inch layered base that drains water, holds roots and nourishes the sedum without conventional soil. The system doesn’t wash away or create dust and is comparatively lightweight.

The plants do the rest. Rowe said the mixed varieties of sedum endure extreme heat and cold and can survive more than 88 days without watering. Sedum’s hardiness and ability to grow in the minimalist root system makes it triumph over weeds.

Green roofs are a concept embraced for years in Germany, where some 12 percent of flat roofs are green. Xero Flor America, L.L.C., the company that donated a portion of the supplies for the MSU project, is a Lansing-based green roof provider founded by the German developer of the Ford system.

Rugh said that the green roof concept is still new in the United States. Existing American flat roofs must be modified to convert to green, and green roofs are initially more expensive, but over time, energy savings, storm water runoff reduction and other benefits make them cost effective.

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